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COSTANZA BBK

A ONE DIMENSIONAL DYNAMIC CODE FOR HIGH TEMPERATURE GAS COOLED REACTORS

by

K. FRIEDRICH *, L. MASSIMO ** and E. VINCENTI **

* BBK
** EURATOM

1970

THTR 93

Report prepared at BBK
Brown Boveri/Krupp Reaktorbau GmbH, Mannheim - Germany

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The programme solves the two-group dynamic neutron diffusion equations in the radial direction.

The temperature feedback on reactivity is obtained through the consideration of the temperature dependence of all of the coefficients of the two-group equations.

The parameters for a consistent zero-dimensional calculation are calculated by the code.

A comparison of zero and one-dimensional calculations shows that it is important to perform in one dimension the thermal calculation, while a one-dimensional neutron flux dynamic calculation is normally not necessary for the safety calculations of high temperature gas cooled reactors.

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ABSTRACT

On the basis of the already existing COSTANZA code for liquid cooled reactors a programme has been developed for the one-dimensional dynamic calculations of the high temperature gas cooled reactors.

The programme solves the two-group dynamic neutron diffusion equations in the radial direction.

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A comparison of zero and one-dimensional calculations shows that it is important to perform in one dimension the thermal calculation, while a one-dimensional neutron flux dynamic calculation is normally not necessary for the safety calculations of high temperature gas cooled reactors.

KEYWORDS

C-CODES
PROGRAMMING
HTGR
GROUP THEORY
NEUTRON FLUX
DIFFUSION
DIFFERENTIAL EQUATIONS
TEMPERATURE
REACTIVITY

I n d e x

COSTANZA BBK

A ONE DIMENSIONAL DYNAMIC CODE FOR HIGH TEMPERATURE GAS COOLED REACTORS*)

1. Introduction

On the basis of the already existing CONSTANZA code for liquid cooled reactors [ref.1] , a programme has been developed for the one dimensional dynamic calculations of the high temperature gas cooled ractors.

The programme solves the two group dynamic neutron diffusion equations in the radial direction.

Two energy group have been considered instead of the usual one-group approximation in order to treat properly the power peaking near the reflector and the effectiveness of reflector control rods. In the undermoderated high temperature reactors it is particularly important to treat properly the slowing down of neutrons in reflector.

The temperature feedback on reactivity is obtained through the consideration of the temperature dependence of all of the coefficients of the two-group equations.

The reactor is radially subdivided in a maximum of 10 regions, including the reflector.
Up to 10 groups of delayed neutrons can be considered.

2. The time-dependent diffusion calculation

The two group equations take the following form:

(1) $$D_1 \nabla^2 \Phi_1 - (\Sigma_{rem1} + N\sigma_{c1} + D_1 B_z^2)\Phi_1 + (1-\beta)(\nu\Sigma_{f1}\Phi_1 + \nu\Sigma_{f2}\Phi_2) + \sum_{i=1}^{k} \lambda_i C_i = \frac{1}{v_1}\frac{\partial \Phi_1}{\partial t}$$

(2) $$D_2 \nabla^2 \Phi_2 - (\Sigma_{a2} + N\sigma_{c2} + D_2 B_z^2)\Phi_2 + p\Sigma_{rem1}\Phi_1 = \frac{1}{v_2}\cdot\frac{\partial \Phi_2}{\partial t}$$

*) Manuscript received on 29 July 1969.

And for each group i of delayed neutrons we have:

$$(3) \quad \frac{\partial C_i}{\partial t} = \beta \left(\nu \Sigma_{f1} \Phi_1 + \nu \Sigma_{f2} \Phi_2 \right) - \lambda_i C_i \qquad i = 1 \ldots k$$

Suffix 1 means fast and 2 means thermal group. The meaning of the symbols is given in appendix.

The quantity p includes all fast absorptions and not only resonances.

The quantity β_{eff} takes into account the higher importance of the delayed neutrons due to the fact that they are born with lower energy than the fission neutrons. About the method of calculating β_{eff} see ref. [2].

The coefficients of the above written equations change from region to region and are temperature dependent. These equations are transformed, with the finite difference method, into a system of linear equations by subdividing the radius of the reactor in a appropriate number of mesh points and the time in constant time steps. The time dependence is discretized in the following way:

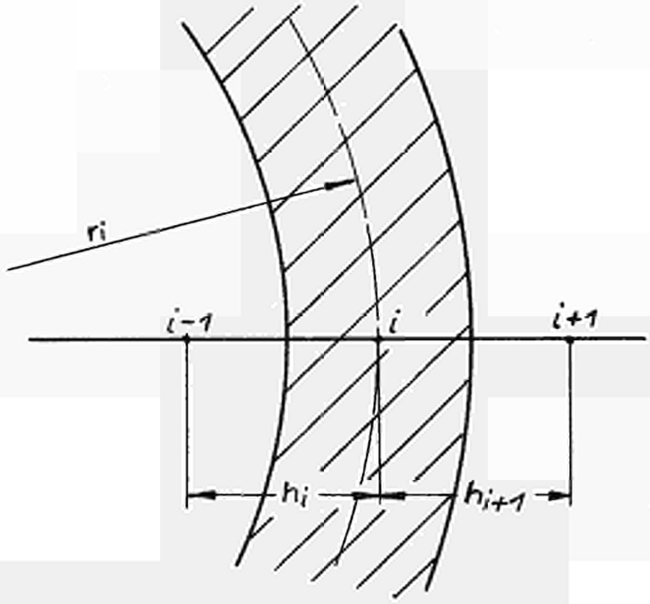
$$(4) \quad \frac{1}{v} \cdot \frac{\partial \Phi}{\partial t} = \frac{1}{v} \cdot \frac{\Phi - \Phi^*}{\Delta t}$$

where Φ^* is the flux value calculated at the previous time step.

At every time step the coefficients can be given new values which are determined according to the temperature feedback.*
Having performed this time discretization and integrating the diffusion equations over annular regions corresponding to each mesh point and substituting to the

*In the common practice it is not necessary to perform the temperature correction of the coefficients at every time step. The programme uses two different time steps, one for the neutron diffusion and a second for the temperatur calculation. This has to be a multiple of the first one.

integrals their finite difference expressions, we obtain at each time step, a system of 2n linear equations (n being the number of mesh points). This system is solved with the direct method discribed in ref. 3.



The flux calculation subroutine has been programmed in double precision because of the smaller precision of the IBM 360 in comparison with the 7090.
In general one can say that a neutronic time step of 1/15 of the minimum period during the transient gives accurate results.

A maximum of 100 mesh points are allowed. Mesh spacing is arbitrary.

The boundary condition $\frac{d\Phi}{dr} = 0$ at the core centre is obtained by defining points 1 and 2 of the mesh symmetrically to the axis and imposing that $\Phi(1) = \Phi(2)$.

At the outer boundary $\Phi(n) = 0$. At every time step the concentration of the delayed neutron precursors are varied according to the last value of the fission density.

Any radial region can be specified as control region. In the control regions control rods are simulated by a poison whose microscopic cross section (equal for all regions) is read in input for the fast and thermal group.

The control poison concentration in each control region is given by two terms: a term which is calculated in a criticality search before beginning the actual dynamic calculation, and a term which is read in input for each control region as function of time. A negative concentration may simulate an increase in reactivity.

Before starting the dynamic calculation the reactor is made critical by iterating on the control poison concentration in all regions specified as control regions. This iteration is performed without calculating k_{eff} but calculating the period corresponding to a certain poison concentration, and iterating until the reciprocal of the period is smaller than a given convergence criterion.

At each time step an average fuel and moderator temperature is clculated for each power producing region. The heat transfer calculation is only performed for those regions which are specified in input as power producing, for all other regions the temperature is supposed to be constant. These temperatures are used in order to obtain the temperature dependent coefficients of the diffusion equations. This temperature dependence has been expressed in the form of a Taylor expansion:

(5) $c=c_o+\alpha(T_f-T_{fo})+\beta(T_m-T_{mo})+\gamma(T_f-T_{fo})^2+\delta(T_m-T_{mo})^2$

T_{fo} and T_{mo} are the fuel and moderator reference temperatures which are calculated for the initial condition.

c is a generical coefficient of the diffusion equation (diffusion coefficient, absorptions cross section, etc...) $c_o, T_f, T_m, T_{fo}, T_{mo}, \alpha, \beta, \gamma, \delta$ are region dependent.

The coefficients α, β, γ an δ are specified in input, and are usually obtained performing several zero-dimensional multigroup calculations with codes of the type of MUPO [ref.4] or CGC-II [ref.5] which are providing few group cross sections as function of fuel and moderator temperature, taking into account Doppler broadening of resonances and the temperature dependence of the neutron spectrum.

3. The heat transfer calculation

The heat balance equation in the j^{th} shell of a fuel element at axial level i is (see symbol list in appendix)

(6) $$P_i F_j - C_j \frac{T_j - T_j^*}{\Delta t} + \frac{T_{j-1} - T_j}{R_{j-1}} - \frac{T_j - T_{j+1}}{R_j} = 0$$

There are as many equations as shells.
After reordering, the coefficients of this system of linear equations form a tridiagonal definite positive matrix. It can therefore be solved by the well known factorization method (see ref. [7] p. 195)

Each temperature T_j is calculated as function of T_{j-1} by the recurrence formula:

(7) $$T_j = \alpha_j + \beta_j T_{j+1}$$

α_j and β_j are constants which are determined by the recurrence formulae:

(8) $$\alpha_j = \frac{k_j + A_j \alpha_{j-1}}{B_j + A_j \beta_{j-1}}$$ (9) $$\beta_j = \frac{C_j}{B_j + A_j \beta_{j-1}}$$

A_j, B_j, C_j, K_j are the coefficients of equation (6) after reordering. They depend only on the physical properties of each shell.

When two fuel element types are present, two systems of linear equations have to be solved at the same time. Let us consider the two equations of type (6) for the outer shells of both fuel elements, together with the coolant heat balance equations.

10) $$T^{(1)} = \alpha^{(1)} + \beta^{(1)} T_c^{\,i}$$

11) $$T^{(2)} = \alpha^{(2)} + \beta^{(2)} T_c^{\,i}$$

12) $$n_1 \frac{T^{(1)} - T_c}{R} + n_2 \frac{T^{(2)} - T_c}{R} - c_p \dot{m} \left(T_c^{\,i} - T_c^{\,i-1}\right) - c_p A \rho \Delta z \frac{T_c^{\,i} - T_c^{\,i*}}{\Delta t} = 0$$

These three equations contain three unknown T_1, T_2, T_c^i, and can be directly solved. Once T_j for the outer shell is known, the recurrence equations (7) provides all the temperatures T_j for both fuel types.

Knowing the percentage of fuel and moderator present in each fuel element shell it is possible to calculate the average fuel and moderator temperature for each core zone. These temperatures are used in equation (5) to obtain the temperature feedback on the two group coefficients.

4. Computation of the parameters for zero dimensional calculations

As a one dimensional calculation is rather time consuming it is thought that many calculations would be performed with other zero dimensional codes while a few cases would be checked with COSTANZA. In zero dimensional codes it is usually necessary to specify the Δk_{eff} which is causing the transient, and the average prompt neutron lifetime l. Both quantities are not specified in COSTANZA, but it is possible to calculate them in order to be able to perform consistent zero dimensional calculations.

The programme can calculate in given regions the poison concentration corresponding to a given Δk_{eff}.
The ν value is devided by k_{eff} and the reactor is made critical reducing the poison concentration in the specified regions. Then ν is set again to the original value and the reactor period T is calculated neglecting the delayed neutrons and the temperature feedback.

The average prompt neutron lifetime is than

(13) $$\ell = \Delta k_{eff} \; T$$

In the COSTANZA code the period T is calculated as the logaritmic derivative of the thermal flux

$$T = \frac{1}{\Phi_2} \frac{\partial \Phi_2}{\partial t} \tag{14}$$

Even neglecting the delayed neutrons the period is not constant at the beginning of a transient. This is due to two reasons: the consideration of two energy groups, and the consideration of various regions with different properties.

First, even in the case of the point model, the two group equation implies as a solution the sum of two exponentials

$$\Phi_2 = A e^{\lambda_1 t} + B e^{\lambda_2 t}$$

one can see that one of the two exponentials vanishes very rapidly with a time constant dependent from the slowing down time.

The second effect is the most important and is due mainly to the reflector, which is returing neutrons to the core with a certain delay and brings therefore a considerable increase in the prompt neutron lifetime.

These effects can be seen in fig. 1. The full line gives the ratio T/T_∞ of the period T calculated by COSTANZA as function of time after a reactivity accident, referred to the asymptotic value T_∞ . The dotted line shows the same curve for a bare reactor. In this second case the period stabilizes very rapidly.

The prompt neutron lifetime must be calculated with the asymptotic period: this means that the programme must calculate until the period has stabilised before using equation (13).

In this way it is possible to obtain automatically a prompt neutron lifetime calculated in two groups and averaged over the reactor volume. A spatial averaging would otherwise have to be calculated with perturbation theory provided the adjoint fluxes have been previously calculated. A two group calculation of l is also important. A calculation with one group extending over the complete energy range would give the average lifetime of all prompt neutrons, including those which do not produce fission. The neutrons absorbed in the resonance region shorten considerably the average lifetime of all prompt neutrons, but should not be considered in l. A calculation of l as sum of the slowing down time and the lifetime of the thermal neutrons would on the contrary give a too high l because it would neglect the epithermal fissions which are in high temperature reactors not negligible.

5. Comparison between COSTANZA and a zero-dimensional code for high temperature reactor calculations

A certain number of comparison calculations have been made between the zero-dimensional DYN code [ref. 9] and COSTANZA

Two reactivity steps have been considered:
a 0.28 % step in a homogeneous core, and a 0.64 % step in a small central region of the THTR two zone core, simulating a rod ejection accident. (The extraction of a control rod in such a short time is not possible in THTR, but the case has been considered in order to have a pessimistic example).

The first case has been calculated in COSTANZA with the following time steps

$$\Delta t_{neutr.} = 0{,}005 \text{ sec}$$

$$\Delta t_{therm} = 0{,}5 \text{ sec}$$

These time steps have been choosen in such a way that smaller steps would not change appreciably the results.
In COSTANZA two fuel element classes have been considered: the first class represents the fresh elements, and the second all remaining elements.

The DYN calculation has been performed twice:
once with two fuel element classes as in COSTANZA and once with only one average fuel element class, calculating the higher power of the fresh element with the consideration of an "age factor" (ratio of macroscopic fission cross section of a fresh element to the average macroscopic fission cross section). In DYN the geometrical power shape is taken into account with a geometrical power shape factor (ratio between maximum and average power).

The results are shown in fig. 2

One can see that the temperatures calculated by DYN are in one case optimistic and in one case pessimistic. There is no appreciable difference in the flux excursion calculated with the zero and one-dimensional model.

The second case (0.64 % reactivity step) has been simulated in COSTANZA with a ramp of 0.002 sec. The time step width has been

$$\Delta t_{neutr} = 0.002 \text{ sec}$$

$$\Delta t_{therm} = 0.01 \text{ sec}$$

Two calculations have been performed with COSTANZA, once localizing the accident to a small central region of 20 cm diameter, and once distributing the reactivity change over the whole core.

Fig. 3 shows the comparison between DYN and these two COSTANZA calculations. There is no appreciable difference in the total reactor power excursion (Q). In the case in which the accident is localized to a small central region (rod ejection) higher modes of the flux distribution are excited for a short time, then the flux takes the form corresponding to the foundamental mode of the new configuration with rod extracted. Fig. 4 shows the change in flux shape as function of time. In order to visualize better the change in shape, all distributions have been renormalized to the initial value.
One can see that after about 0.02 sec the flux has settled to the new foundamental mode.

Fig. 5 shows the effect of changes in the prompt neutron lifetime on the DYN results.
The proper l given by COSTANZA is $7.0 \cdot 10^{-4}$ sec. A one-group zero-dimensional calculation for the homogenized case gives $l \approx 5.0 \cdot 10^{-4}$. A two-group calculation performed by COSTANZA without reflector gives the value $6.2 \cdot 10^{-4}$.
One can see that if the reactor is nearly prompt critical, these inaccuracies in l lead to considerable inaccuracies in the power excursion.

In fig. 6 is shown the comparison of curves of temperature as function of time obtained from the one and zero dimensional calculations for the 0.64 % reacitivity step. There is an appreciable difference in the maximum gas and fuel element temperature between the two calculations, although in fig. 3 there is no appreciable difference in the power excursion. This is due to the fact that in the zero dimensional calculation the axial temperature profile is supposed to be constant with time, while COSTANZA recalculates it at every thermal time step. This change in axial temperature profile is shown in fig. 7.

The result of this investigation is that, for the particular cases which have been considered, there is a need for a one dimensional thermal calculation, but not for a one dimensional neutron flux calculation.

A one dimensional neutron flux calculation is needed when either the flux shape in the foundamental mode is strongly modified by the transient, or when the higher modes bring a considerable contribution to the reactor temperature. Modifications of the foundamental modes can be easily forseen. If these modifications can appreciably change the geometrical power shape factor, a one dimensional dynamic calculation is required.

The contribution of the higher modes to the core temperatures is negligible in high temperature reactors, except for accidents considerably bigger than those studied in our examples.
This is due to the very high heat capacity of the high temperature reactor fuel.

One can see from fig. 4 that the higher modes have practically disappeard after 0.05 sec. As the thermal capacity of the THTR fuel elements is about 2 $[MWsec/m^3\ {}^{\circ}C]$ even in a pessimistic adiabatic assumption, one needs an average power density of 400 MW/m^3 to have a temperature increase of $10^{\circ}C$

in 0.05 sec. In the case of a 0.64 % reactivity step the overall power increases in 0.05 sec. only of less than a factor 2, and even in the central region does not increase more than of a factor 13. It does not appear to be possible with forseeable accidents to reach a power density higher than 400 MW/m^3 in 0.05 sec.

6. Nomenclature

D	Diffusion coefficient
Φ	Neutron flux
B_z^2	Axial buckling
Σ_{rem}	Macroscopic removal cross section (absorption + slowing down)
Σ_f	Macroscopic fission cross section
ν	Number of secondary neutrons per fission
Σ_a	Macroscopic absorption cross section (fission + capture)
σ_c	Microscopic control poison cross section
N	Control poison concentration
C_i	Concentration of delayed neutron precursor, group i
k	Total number of delayed neutron groups
λ_i	Decay constant of delayed neutron precursor, group i
β	Delayed neutron fraction
β_{eff}	Effective delayed neutron fraction
p	Fast absorption excape probability
Σ_{1-2}	Macroscopic slowing down cross section
V	Neutron velocity
P_i	Power of a fuel element at level i
F_j	Fraction of power generated in shell j
C_j	Shell j thermal capacity
R_j	Thermal resistance between shell j and the next one or between the last shell and the coolant.
T_j	Temperature shell j
T_j^*	Temperature shell j for the previous time step.
$T^{(1)}, T^{(2)}$	Outer shell temperature in the two fuel element classes
T_c^i	Coolant temperature at axial level i
n_1, n_2	Number of class 1 and 2 elements present at level i
c_p	Coolant specific heat
ρ	Coolant density
$\dot{m}$	Mass flow
A	Channel section
Δz	Height of an axial zone

7. Literature

[1] G. Forti, E. Vincenti
The codes Costanza for the dynamics of liquid-cooled nuclear reactors EUR 3633 e 1967

[2] K. Friedrich, E. Inführ, L. Massimo
Spezielle Probleme der Dynamik bei gasgekühlten graphitmoderierten Hochtemperaturreaktoren
ATKE 13 - 16 (80 - 83) 1968

[3] R. Monterosso, E. Vincenti
Finite difference method for solving the spatio-temporal diffusion equation in the two groups approximation
EUR 596. e (1964)

[4] J. Schlösser
MUPO. An IBM-7090 programme to calculate neutron spectra and multi-group constants. D.P. Report 172

[5] C. V. Smith, H. A. Vieweg
GGC - II GA - 4436 December 17, 1963

[6] K. Friedrich, E. Inführ, L. Massimo
Rechenmodell für die Berechnung von schnellen Leistungsexkursionen bei Reaktoren mit kontinuierlicher Beschickung
ATKE 1/69

[7] S. Varga
Matrix iterative Analysis Prentice Hall Inc.

[8] A. Agazzi, G. Forti, E. Vincenti EUR 3171 e
A cylindrical one dimensional dynamic code for liquid cooled multichannel nuclear reactors.

[9] K. Friedrich, E. Inführ, L. Massimo
DYN, ein Dynamikprogramm für Kugelhaufenreaktoren
Euratom report in publication

8. Input description

A title card is the first input card of each problem. A vector of 3500 memory positions DATA (1) ... DATA (3500) contains all the data. Since entire groups of memory positions are zero, it is possible to read different sets of significant data; each set must be preceded by a card containing the integers K_{i1}, K_{i2} defining the first and last datum of the set. K_{i1} and K_{i2} are given in integer form adjusted to the right at columns 12 and 24. The last set of a problem is indicated by -1 in columns 1 and 2. The data of each set are all in floating form (FORMAT E12.8). Any number of problems may be run in sequence and only the data changed in the preceding problem need to be given. A title card must be present for each problem.

TITLE 1

col.12/ col.24/

K_{11} K_{12}

DATA(K_{11}) DATA(K_{11}+1) DATA(K_{11} ...DATA(K_{12}) 1st set

K_{21} K_{22}

DATA(K_{21}) DATA.............etc................ 2nd set

....

-1 K_{n1} K_{n2}

DATA(K_{n1}) .... last set

TITLE 2

.........................etc.................

Title Card - a positive integer in columns 1-6 means that the problem is the last of the run. Any alphanumerical information may appear in cols. 7 - 72 and will be printed in the output.

DATA Nº	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
1	DELT	t(sec) neutronic time step for transient		1/15 of minimum expected inverse period generally gives good results.
2	DELT	t(sec) neutronic time step for initialization (10^{20} if source problem)		
3	SI	Reactor power in Watt		
4	IMAX	Number of mesh points	≤ 100	Point 1 is symmetrical of point 2 with reactor axis. Last point corresponds to the outer (extropolated) boundary of the reactor.
5	NREG	Number of regions (for different composition and/or typical coolant channel characteristics)	≤ 10	
6	NRIT	Number of delayed neutrons groups	≤ 10	
7	Bu	B^2 - Transverse buckling (cm-2) (same for all regions and groups)		
8	IDST	Number of steps for initialization (50)		
9	ITCR	max. N of iterations to find correspondence between period and poison (20)		
10	NCAN	Number of power producing regions (regions for which a thermal calculation is performed)	≤ 10	
11	KPC	Thermal calculation is done every KPC neutronic step		

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
12	KTME1	Average temperatures are printed every KTME1 thermal steps		
13	KMA1	Temperature maps are printed every KMA1 KTME1 thermal step		
14	CALU	Core height		
15	ITCI	N of flux iteration in CRITIC before calling CANPAL (5)		
31-40	BETA	βi delayed neutron yelds per fission		
41-50	DLI	λi delayed neutron precursors decay constants		
61-71	I1-I2	Region boundary mesh numbers		
73	VM	V_1 neutron velocity for thermal group		
74	WM	V_2 neutron velocity for fast group		
75		σ_{c1} microscopic control poison fast cross section		
76		σ_{c2} microscopic control poison thermal cross section		

NUCLEAR CONSTANTS
Region 1

81	D1	Diffusion coefficient-fast group		
82	SR	$\Sigma_r = \Sigma_{a1} + \Sigma_{s1}$ removal cross section		
83	P	p resonance escape probability		
84	SF1	$\nu \Sigma_{f1}$		

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
85	AEQUI	Energy/fission [Wsec/fission]		
86	SOR	Neutron flux density (fast)		
87	D2	Diffusion coefficient-thermal group		
88	SA	Σ_{a2} thermal absorption cross section		
89	SP	blank		
90	SF	$\nu\Sigma_{f2}$		
91	ANU	Number of secondary neutrons per fission ν		
92	ICAN	≥ 1 if the region is a power producing region for which a thermal calculation has to be performed (Reflector = 0)		
93-104	etc.	same for 2nd region		
201-300	X	Distance of mesh points from axis		They are arbitrary, except X(1) = -X(2)

CONTROL ROD MOVEMENT

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
301-330	-	Times of successive poison values		The first time value must always be 0. Any number of successive times (up to 30) and corresponding N_c values may be given for each region, the code will linearly interpolate between the values to get the current N_c for each time step. After the last time given, N_c will be fixed to its last value.
331-360		Corresponding values of $N_c(t)$ for first region		
361-390		Times for 2nd region		
391-420		N_c for 2nd region		

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES

DESCRIPTION OF THE TEMPERATURE
DEPENDENCE OF THE TWO GROUP COEFFICIENTS

The coefficients C_K are numbered as follows

$C_1 = D_1$

$C_2 = \Sigma_{rem}$

$C_3 = p$

$C_4 = \nu\Sigma_{f1}$

$C_5 = V_1$

$C_6 = D_2$

$C_7 = \Sigma_{a2}$

$C_8 = \nu\Sigma_{f2}$

$C_9 = V_2$

The thermal dependence is given as a Taylor expension

$$C_K^N = C_{K_0}^N + CTN(K,1,N)\,\Delta T_f + CTN(K,2,N)\,\Delta T_m + CTN(K,3,N)\,\Delta T_f^2 + CTN(K,4,N)\,\Delta T_m^2$$

901-1380 CTN (K,L,N) = DATA (900 + 12 (L-1) + 48 (N-1)+K)

N is the power producing region number (channel number) numbering from the core center the regions for which a heat transfer calculation is performed

1381-1390	RAVI	Fraction of power generated in the first fuel element class, for each region
1391-1400	RAIN	Fraction of power generated in the second fuel element class, for each region (for each region RAIN + RAVI = 1.0)

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
1401-1410		Fuel reference temperature for the temperature coefficient calculation (for each region)		
1411-1420		Moderator reference temperature for the temperature coefficient calculation (for each region)		
1501	DK	Excess reactivity	Δk_{eff}	If $DK \neq 0$ the program calculates only the poison concentration and the prompt lifetime.
1521-1530	KV1	Regions for which the poison concentration corresponding to DK has to be calculated.		
1601-1610	KV(I)	I if poison is present in region I O if not		
1611	SPRG	Second guess of control poison concentration N_c (same for all region checked)		1st guess is zero
1612	DAPF	convergence criterium for search. Reciprocal of period will be $\leq$ DAPF		
1613	LF	Maximum number of trials for search (100)		

PRINTING INSTRUCTIONS

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
1851+6n	KTP	Number of time steps for n^{th} printing pattern		n=0, 1, 2 etc.
1852+6n	I1P	Number of time steps after which the more frequent type of printing is done		As many cards as wanted can be given, allowing different successive printing patterns.
1853+6n	I1S	Type of more frequent output 1, 2, 3		After the last is

DATA N	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
			1 only average fluxes and period 2 complete map of fluxes and delayed neutron precurors concentration 3 average fluxes in the reactor and region by region	completed the calculation stops and a final print is done.Then the control is transfered to the beginning of the programme to start a new problem, unless the title card is checked, in which case the run is stopped.
1854+6n	I2P	Number of time steps for less frequent type of output. Must be multiple of I1P and divisor of KTP		
1855+6n	I2S	Same as I1S for less frequent 1, 2, 3 output		
1856+6n		Not employed		

AXIAL POWER DISTRIBUTION

(These date should be given for each power producing region)

DATA N	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
2001-2020		Axial power distribution for 1st power producing region. Relative values are significant.Normalization is performed by the code.		The axial power distribution may be different for each power producing region and is kept constant during transient.
2021-2040		Same for 2nd channel		As many point as there are axial zones in thermal calculation. Must be given for each channel (see further).

COOLANT CHANNELS DATA

(These data should be given for each power producing region)

DATA N	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
2501	NSV	Number of axial zones		
2502	CALU	Length of channel [cm]		

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
2503	SEZ	Channel cross section		
2504	SC	Gas specific heat [Joule /g ^{o}C]		
2505	RØ	Gas density [g / cm^3]		
2506	N1	Number of shells in fuel element class 1		
2507	PALN1	Number of class 1 elements per axial zone corresponding to the section SEZ		
2509	N2			
2510	PALN2	Same as before for class 2		
2512		Porosity $\frac{\text{empty volume}}{\text{total volume}}$		
2801-2810	RES1	thermal resistance between shells in fuel element class 1		
2811-2820	CPT1	thermal capacity for each shell of class 1 elements		
2821-2830	VØS1	Shell volume for each shell of class 1 elements		
2831-2840	PZO1	Power fraction for each shell of class 1 elements		
2841-2850	FF1	Percentage of fuel for each shell of class 1 elements		
2851-2860	FM1	Percentage of moderator for each shell of class 1 elements		

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES
2901-2910	RES2	Same data for class 2 elements		
2911-2920	CPT2	" " "		
2921-2930	VØS2	" " "		
2931-2940	PZO1	" " "		
2941-2950	FF2	" " "		
2951-2960	FM2	" " "		
		The following condition must be satisfied: $$\sum_{I=1}^{N1} FN1(I) + \sum_{I=1}^{N2} FN2(I) = 1$$ $$\sum_{I=1}^{N1} FF1(I) + \sum_{I=1}^{N2} FF2(I) = 1$$		
2521		Inlet temperature of coolant at equilibrium initial conditions (zero if inlet temperature is tabulated as function of time)		
2522		Step of coolant inlet temperature		Only if DATA (2521)≠O.
2523		Value of $\frac{dT}{dt}$ for ramp in coolant inlet temperature		
2524	$\dot{m}$	Initial value of coolant mass flow (zero if tabulated)		
2525		Step of coolant mass flow		Only if DATA (2524)≠O.
2526		Value of $\frac{d\dot{m}}{dt}$ for ramp in coolant mass flow		Only if DATA (2524)≠O.
2531-2560		Same data for 2nd channel		
etc....				

DATA N°	VARIABLE NAME	DESCRIPTION	ALLOWABLE VALUES	NOTES

VARIABLE INLET TEMPERATURE
(these data have to be given for each power producing region)

3001-3010		Inlet temperature values for 1st channel		Only if DATA (2521) and analogous are 0.
3101-3110		Corresponding times for 1st channel		First time must be 0.
3011-3020		Same for 2nd channel		

VARIABLE COOLANT MASS FLOW
(these data have to be given for each power producing region)

3201-3210		Mass flow values for 1st channel		
3301-3310		Corresponding times		First must be 0.

```
      BLOCK DATA
      COMMON /CDAT/ DATA(3500)
      REAL DATA /3500*0./
      END
```

```
            C      COSTCI
            C      MAIN
            C                    COSTANZA   -   CILINDRICO
            C
0001               REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2
0002               COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)
0003               COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,
                  1IM1,NK,   SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,               SPRG,DAP
                  2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
                  3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),V
                  4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)
                  5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),
                  6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),
                  8X(100),              VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10
                  90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)
                  A,BI1(100),BI2(100),EP1(100),EP2(100),TO,               DER1(100),D
                  BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100
                  C),CTN(12,4,10),D1I(10),SRI(10),ALAN  ,SF1I(10),WI(10),D2I(10),SAI(
                  D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)
                  E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)
0004               COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10)
                  1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1
0005               COMMON/CDAT/DATA(3500)
0006               DIMENSION ALFA(16),ITIPO(10),          POTZ(10)
0007               DIMENSION  KV1(10),                 VEPF(10),VEPT(10),CONTR(10)
0008               PINT=0.
0009               DO 9001 I=1,3500
0010          9001 DATA(I)=0.0
0011           110 READ (5,20)LAST,ALFA
0012            20 FORMAT (I6,16A4)
0013               WRITE (6,23)
0014            23 FORMAT (1H1,35X,20HCOSTANZA  CILINDRICO//)
0015               WRITE (6,22)ALFA
0016            22 FORMAT (1H0,30X,16A4/////)
0017               CALL AZER
0018           100 READ(5,101)JKLM,K1,K2,(DATA(I),I=K1,K2)
0019           101 FORMAT(2I6,I12/(6E12.8))
0020               WRITE (6,102)(I,DATA(I),I=K1,K2)
0021           102 FORMAT (6(I5,E14.6))
0022               IF(JKLM.GE.0)GOTO 100
0023               PINT=0.0
0024               TO=0.0
0025               IT=0
0026               DELT=DATA(2)
0027               SI=DATA(3)
0028               IMAX=DATA(4)+0.0001
0029               NREG=DATA(5)+0.0001
0030               NRIT=DATA(6)+0.0001
0031               BU=DATA(7)
0032               IDST=DATA(8)+0.0001
0033               ITCR=DATA(9)+0.0001
0034               NCAN=DATA(10)+0.1
0035               KPC=DATA(11)+0.1
0036               DT=DELT*FLOAT(KPC)
0037               KTME1=DATA(12)+0.1
0038               KMA1=DATA(13)+0.1
0039               KTE=1
0040               KMAP=0
0041               KTMED=0
0042               KCAN=0
0043               DO 104 I=1,NRIT
0044               BETA(I)=DATA(I+30)
0045           104 DL(I)=DATA(I+40)
```

```
      DO 105 I=1,NREG
      I1(I)=DATA(I+60)+0.0001
      I2(I)=DATA(I+61)+0.0001
  105 CONTINUE
      DO 1 I=1,NREG
    1 KV(I)=DATA(I+1600)
      DO 48 M=1,NREG
      TMUI(M) = DATA (1400 + M)
      TMC1I(M)= DATA (1410 + M)
      TMC2I(M)=DATA (1420 + M)
      TCI(M)=  DATA (1430 + M)
   48 CONTINUE
      VM = DATA(73)
      WM = DATA(74)
      IDF=80
      DO 107 M=1,NREG
      D1(M)=DATA(IDF+1)
      SR(M)=DATA(IDF+2)
      P(M)=DATA(IDF+3)
      SF1(M)=DATA(IDF+4)
      AEQUI(M)=DATA(IDF+5)
      SOR(M)=DATA(IDF+6)
      D2(M)=DATA(IDF+7)
      SA(M)=DATA(IDF+8)
      SPR(M)=DATA(IDF+9)
      SP(M)=SPR(M)
      SF(M)=DATA(IDF+10)
      ANU(M)=DATA(IDF+11)
      ICAN(M)=DATA(IDF+12)
      IDF=IDF+12
  107 CONTINUE
      DO 108 I=1,IMAX
      AB2(I)=0.
  108 X(I)=DATA(I+200)
      X(1)=-X(2)
      P1(IMAX)=0.
      P2(IMAX)=0.
      P1(1)=P1(2)
      P2(1)=P2(2)
      SBETA=0.
      IF(NRIT.LE.0)GOTO 103
      DO 800 K=1,NRIT
  800 DETA(K)=BETA(K)/DL(K)
  103 CONTINUE
      IM1=IMAX-1
      NK=IMAX-2
      DO16I=2,IM1
      BE(I)=(X(I)+(X(I+1)-X(I))/2.)/(X(I+1)-X(I))
      VOL1(I)=(X(I)+(X(I+1)-X(I))/4.)*(X(I+1)-X(I))/2.
   16 VOL2(I)=(X(I)-(X(I)-X(I-1))/4.)*(X(I)-X(I-1))/2.
      VOL2(IMAX)=(X(IMAX)-(X(IMAX)-X(IM1))/4.)*(X(IMAX)-X(IM1))/2.
      VOL(2)=((X(2)+X(3))/2.)**2*3.1416
      DO 17 I=3,IM1
   17 VOL(I)=(VOL1(I)+VOL2(I))*6.2832
      VOLT=0.
      DO 8 I=2,IM1
    8 VOLT=VOLT+VOL(I)
      VOLT=VOLT+6.2832*VOL2(IMAX)
      DO 300 M=1,NREG
      IS=I1(M)+1
      ID=I2(M)-1
      VOLO=6.2832*VOL1(IS-1)
      DO 301 I=IS,ID
```

```
0109        301 VOLO=VOLO+VOL(I)                                           MAI 1210
0110        300 VR(M)=VOLO+6.2832*VOL2(ID+1)                               MAI 1220
0111            WRITE(6,69) (VR(M),M=1,NREG)                               MAI 1230
0112         69 FORMAT(1H1,10X,'SEZIONE DELLE REGIONI'///10E12.4)          MAI 1240
          C
0113            DO 420 M=1,NREG
0114            SPF1(M)=0.
0115        420 SPT1(M)=0.
0116            ALAN=1.
0117            DK = DATA(1501)                                            MAI 1250
0118            IF(ABS(DK)-1.0E-10)452,452,451
0119        451 CONTINUE
0120            DO 450 M=1,NREG                                            MAI 1260
0121        450 KV1(M) = DATA(M+1520)                                      MAI 1270
0122            LAN=-10
0123        452 CONTINUE
          C
0124        401 CONTINUE
0125            CALL MAT
0126         31 DO 33 I=1,IM1                                              MAI 1300
0127            P1(I)=SI                                                   MAI 1310
0128         33 P2(I)=SI                                                   MAI 1320
0129            CALL INIZ                                                  MAI 1330
0130            CALL STAMPA(2)                                             MAI 1340
0131            IF (NCAN)1200,1200,1201                                    MAI 1350
0132       1201 CONTINUE                                                   MAI 1360
0133            CALL DCAN(DT)                                              MAI 1370
0134            CALL POREG                                                 MAI 1380
0135            N = 0                                                      MAI 1390
0136            DO 1009 M=1,NREG                                           MAI 1400
0137            D1I(M)=D1(M)                                               MAI 1410
0138            SRI(M)=SR(M)                                               MAI 1420
0139            PI(M)=P(M)                                                 MAI 1430
0140            SF1I(M)=SF1(M)                                             MAI 1440
0141            D2I(M)=D2(M)                                               MAI 1450
0142            SAI(M)=SA(M)                                               MAI 1460
0143            SPRI(M)=SPR(M)                                             MAI 1470
0144            SFA(M)=SF(M)                                               MAI 1480
0145            IF (ICAN(M))1009,1009,1010                                 MAI 1490
0146       1010 N=N+1                                                      MAI 1500
0147            CALL CANPAL(0.0,N,TO,POWER(M))                             MAI 1510
0148       1009 CONTINUE                                                   MAI 1560
0149            DO 1020  N=1,NCAN                                          MAI 1570
0150            NKK = 48*(N-1)                                             MAI 1580
0151            DO 1020  L=1,4                                             MAI 1590
0152            LTAY= 12*(L-1)                                             MAI 1600
0153            DO 1020  K=1,12                                            MAI 1610
0154            CTN(K,L,N) = DATA(900+NKK+LTAY+K)                          MAI 1620
0155       1020 CONTINUE                                                   MAI 1630
0156            WRITE (6,1021)                                             MAI 1640
0157       1021 FORMAT (1H0////,27H COEFFICIENTI  TEMPERATURA ,///)        MAI 1650
0158            DO 1022  N=1,NCAN                                          MAI 1660
0159            WRITE (6,1023) N                                           MAI 1670
0160       1023 FORMAT (1H0//,10H CANALE  NI3,//)                          MAI 1680
0161            WRITE (6,1024)                                             MAI 1690
0162       1024 FORMAT (1H0//,5X,6H TERM.,6X,2HD1,9X, 9HS.REMOVAL,8X,1HP,9X,15H MAI 1700
               1FAST FISSION,5X,1HW)                                       MAI 1710
0163            DO 1025  L=1,4                                             MAI 1720
0164       1025 WRITE(6,1026) L,(CTN(K,L,N),K=1,5)                         MAI 1730
0165       1026 FORMAT(1H0 ,9X,I2,4X,6E14.6)                               MAI 1740
0166            WRITE (6,1027)                                             MAI 1750
0167       1027 FORMAT (1H0//,5X,6H TERM.,6X,2HD2,7X,13HTH.ABSORPTION,4X,6HPOISON,MAI 1760
               17X,11HTH. FISSION,5X,1HV)                                  MAI 1770
```

```
      DO 1028  L=1,4                                                    MAI 1780
 1028 WRITE(6,1029) L,(CTN(K,L,N),K=7,11)                               MAI 1790
 1022 CONTINUE                                                          MAI 1800
 1029 FORMAT(1HO ,9X,I2,4X,5E14.6)                                      MAI 1810
 1200 CONTINUE                                                          MAI 1820
      IF (ITCR)35,35,34                                                 MAI 1830
   34 CALL CRITIC                                                       MAI 1840
      CALL STAMPA(2)                                                    MAI 1850
   35 CALL STAMPA(3)                                                    MAI 1860
      IC = 0                                                            MAI 1870
      DO 46 M = 1,NREG                                                  MAI 1880
      IF (ICAN(M)) 46,46,47                                             MAI 1890
   47 IC=IC+1                                                           MAI 1900
      WRITE (6,41) IC,T                                                 MAI 1910
   41 FORMAT(1HO////9H CANALE NI3,5X,3HT =F8.3//)                       MAI 1920
      WRITE (6,42)                                                      MAI 1930
   42 FORMAT (1HO//12H SFERE VIVE )                                     MAI 1940
      DO 53 I=1,NS                                                      MAI 1950
   53 WRITE (6,43) I,(TP1(J,I,IC),J=1,N1P1)                             MAI 1960
   43 FORMAT (1HO,I5,10F10.3)                                           MAI 1970
      WRITE (6,44)                                                      MAI 1980
   44 FORMAT (1HO//,14H SFERE INERTI )                                  MAI 1990
      DO 55 I=1,NS                                                      MAI 2000
   55 WRITE (6,45) I,(TP2(J,I,IC),J=1,N2)                               MAI 2010
   45 FORMAT (1HO,I5,10F10.3)                                           MAI 2020
      WRITE (6,90) (TMED(IC,I),I=1,3)                                   MAI 2030
   90 FORMAT (1HO///21H  TEMPERATURE MEDIE  //,5X,4HTU =F10.3,5X,5HTG  =MAI 2040
     1F10.3,5X,6HTGAS =F10.3)                                           MAI 2050
   46 CONTINUE                                                          MAI 2060
      WRITE(6,779)
  779 FORMAT(////20X,45HCOSTANTI FISICHE DOPO IL CALCOLO DI CRITICITA///
     1)
      DO 777 M=1,NREG
      WRITE(6,669)(D1(M),SR(M),P(M),SF1(M),AEQUI(M),SOR(M),
     1D2(M),SA(M),SPR(M),SF(M),ANU(M),ICAN(M))
  669 FORMAT (6E20.5/5E20.5,I20)
  777 CONTINUE
      WRITE(6,799) (M,POWER(M),M=1,NCAN)
  799 FORMAT (////10X,18HPOTENZE DEI CANALI///10(I2,5X,E12.5))
      DELT=DATA(1)
      DT=DELT*FLOAT(KPC)
C
      IF(ABS(DK)-1.0E-10) 402,402,403
  403 IF (LAN) 404,404,405
  404 DO 400 M=1,NREG                                                   MAI 2100
      SPF1(M) = SMPF(M)                                                 MAI 2110
      SPT1(M) = SMPT(M)                                                 MAI 2120
  400 KV(M) = KV1(M)                                                    MAI 2130
      ALAN = 1. / ( 1. + DK )                                           MAI 2140
      LAN=+1000
      GO TO 34
  405 ALAN=1.0
      CALL MAT
      VITAM1 = 0.0
  430 CONTINUE
      DO 432 I=1,IMAX
      TN1(I)=DER1(I)*P1(I)
  432 TN2(I)=DER2(I)*P2(I)
      CALL FLUSSI
      IT=IT+1
      TO=DELT*FLOAT(IT)
      IF(IT-10) 430,430,431
  431 CONTINUE
```

```
0227          DP=(PM2-PMPT)/DELT
0228          PER=(PM2+PMPT)/(DP*2.0)
0229          VITAM=DK*PER
0230          WRITE(6,436) DK,VITAM
0231          IF (ABS((VITAM-VITAM1)/VITAM) - 0.00001) 9003,9002,9002
0232     9002 VITAM1 = VITAM
0233          IT=0
0234          GO TO 430
0235     9003 DO 433 M=1,NREG
0236          VEPF(M)=SMPF(M)-SPF1(M)
0237          VEPT(M)=SMPT(M)-SPT1(M)
0238          CONTR(M)=VEPT(M)/DATA(76)
0239      433 CONTINUE
0240      436 FORMAT (1H0////,14H  REACTIVITY =,F10.6,10X,11HMEAN LIFE =,F10.6,/
         1/)
0241          WRITE(6,437) (KV(I),I=1,NREG)
0242      438 FORMAT (1H0/,21H POISON CONCENTRATION,//,10E13.5)
0243      437 FORMAT (1H0////,18H PERTURBED REGIONS,//,I8,9I13)
0244          WRITE (6,438) (CONTR(M),M=1,NREG)
0245          IF (LAST)110,110,9000
0246      402 CONTINUE
0247          DO 80 K=1,NRIT
0248          DLDT(K)=DL(K)*DELT
0249          DETA(K)=BETA(K)*DELT
0250       80 SBETA=SBETA+BETA(K)
0251          CALL MAT
0252          CALL TEST
0253          KS=0
0254          KST=1851
0255     1000 CONTINUE
0256          KTP=DATA(KST)+0.0001
0257          IF (KTP)106,106,127
0258      127 I1P=DATA(KST+1)+0.0001
0259          IS1=DATA(KST+2)+0.0001
0260          I2P=DATA(KST+3)+0.0001
0261          IS2=DATA(KST+4)+0.0001
0262          DO 13 KK=1,KTP,I2P
0263          DO 14 LL=1,I2P,I1P
0264          DO 15 MM=1,I1P
0265          IT=IT+1
0266          TO=DELT*FLOAT(IT)
0267          IF (NCAN)1011,1011,1203
0268     1203 CONTINUE
0269          KCAN=KCAN+1
0270          IF (KCAN-KPC)1011,1012,1012
0271     1012 KCAN=0
0272          N=0
0273          KTMED=KTMED+1
0274          CALL POREG
0275          DO 1013 MR=1,NREG
0276          IF (ICAN(MR))1013,1013,1015
0277     1015 N=N+1
0278          POTZ(N)=POWER(MR)
0279          CALL CANPAL(1.0,N,TO,POWER(MR))
0280          D1(MR)=D1I(MR)+CTN(1,1,N)*(TMED(N,1)-TMUI(MR))+CTN(1,2,N)*(TMED(N,
         12)-TMC1I(MR))+CTN(1,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(1,4,N)*(TMED(
         2N,2)-TMC1I(MR))**2
0281          SR(MR)=SRI(MR)+CTN(2,1,N)*(TMED(N,1)-TMUI(MR))+CTN(2,2,N)*(TMED(N,
         12)-TMC1I(MR))+CTN(2,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(2,4,N)*(TMED(
         2N,2)-TMC1I(MR))**2
0282          P(MR)=PI(MR)+CTN(3,1,N)*(TMED(N,1)-TMUI(MR))+CTN(3,2,N)*(TMED(N,2)
         1-TMC1I(MR))+CTN(3,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(3,4,N)*(TMED(N,
         22)-TMC1I(MR))**2
```

```
0283          SF1 (MR)=SF1I(MR)+CTN(4,1,N)*(TMED(N,1)-TMUI(MR))+CTN(4,2,N)*(TMEDMAI 2920
             1(N,2)-TMC1I(MR))+CTN(4,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(4,4,N)*(   MAI 2930
             2TMED(N,2)-TMC1I(MR))**2                                             MAI 2940
0284          W(MR)=WI(MR)+CTN(5,1,N)*(TMED(N,1)-TMUI(MR))+CTN(5,2,N)*(TMED(N,2)MAI 2950
             1-TMC1I(MR))+CTN(5,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(5,4,N)*(TMED(N,MAI 2960
             22)-TMC1I(MR))**2                                                    MAI 2970
0285          D2(MR)=D2I(MR)+CTN(6,1,N)*(TMED(N,1)-TMUI(MR))+CTN(6,2,N)*(TMED(N,MAI 2980
             12)-TMC1I(MR))+CTN(6,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(6,4,N)*(TMED(MAI 2990
             2N,2)-TMC1I(MR))**2                                                  MAI 3000
0286          SA(MR)=SAI(MR)+CTN(7,1,N)*(TMED(N,1)-TMUI(MR))+CTN(7,2,N)*(TMED(N,MAI 3010
             12)-TMC1I(MR))+CTN(7,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(7,4,N)*(TMED(MAI 3020
             2N,2)-TMC1I(MR))**2                                                  MAI 3030
0287          SF(MR)=SFA(MR)+CTN( 8,1,N)*(TMED(N,1)-TMUI(MR))+CTN( 8,2,N)*(TMED(MAI 3070
             1N,2)-TMC1I(MR))+CTN( 8,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN( 8,4,N)*(TMAI 3080
             2MED(N,2)-TMC1I(MR))**2                                              MAI 3090
0288          V(MR)=VI(MR)+CTN( 9,1,N)*(TMED(N,1)-TMUI(MR))+CTN( 9,2,N)*(TMED(N,MAI 3100
             12)-TMC1I(MR))+CTN( 9,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN( 9,4,N)*(TMEMAI 3110
             2D(N,2)-TMC1I(MR))**2                                                MAI 3120
0289     1013 CONTINUE                                                            MAI 3130
0290          CALL MAT                                                            MAI 3140
0291          IF (KTMED-KTME1)1011,1107,1107                                      MAI 3150
0292     1107 KTMED=0                                                             MAI 3160
0293          WRITE (6,1150)TO                                                    MAI 3170
0294     1150 FORMAT (1H0///,21H  TEMPERATURE MEDIE   ,5X,4HTO =F10.4///,4X,1HM, MAI 3180
             110X,2HTU,12X,3HTG,12X,4HTGAS///)                                    MAI 3190
        C                                                                         MAI 3200
0295          VTOTM = 0.0                                                         MAI 3210
0296          VTOT  = 0.0                                                         MAI 3220
0297          TBREN = 0.0                                                         MAI 3230
0298          TMODM = 0.0                                                         MAI 3240
0299          TGAS  = 0.0                                                         MAI 3250
0300          M     = 0                                                           MAI 3260
0301          DO 1152 J=1,NREG                                                    MAI 3270
0302          IF (ICAN(J)) 1152,1152,2000                                         MAI 3280
0303     2000 M = M + 1                                                           MAI 3290
0304          TBREN = TBREN + VR(J) * TMED(M,1)                                   MAI 3300
0305          TMODM = TMODM + VR(J) * TMED(M,2)                                   MAI 3310
0306          TGAS  = TGAS  + VR(J) * TMED(M,3) * DATA(2494 + 30*M)               MAI 3320
0307          VTOT  = VTOT  + VR(J)                                               MAI 3330
0308          VTOTM = VTOTM + VR(J) * DATA(2494 + 30*M)                           MAI 3340
0309          WRITE (6,1151)M,(TMED(M,I),I=1,3)                                   MAI 3350
0310     1151 FORMAT (I5,4F15.2)                                                  MAI 3360
0311     1152 CONTINUE                                                            MAI 3370
0312          TBREN = TBREN / VTOT                                                MAI 3380
0313          TMODM = TMODM / VTOT                                                MAI 3390
0314          TGAS  = TGAS / VTOTM                                                MAI 3400
0315          WRITE (6,2020) TBREN,TMODM,TGAS                                     MAI 3410
0316     2020 FORMAT (1H0///23H MITTL.BRENNST.TEMP. = F12.2,5X,20HMITTL.MODER.TEMAI 3420
             1MP. = F12.2,5X,18HMITTL.GAS.TEMP. = F12.2)                          MAI 3430
        C                                                                         MAI 3440
0317          KMAP=KMAP+1                                                         MAI 3450
0318          IF (KMAP-KMA1)1011,1108,1108                                        MAI 3460
0319     1108 KMAP=0                                                              MAI 3470
0320          DO 1109 N=1,NCAN                                                    MAI 3480
0321          WRITE (6,1110) N,TO,POTZ(N)                                         MAI 3490
0322     1110 FORMAT (1H0////9H CANALE NI3,5X,4HTO =F8.3,5X,7HPOWER =E12.5//)     MAI 3500
0323          WRITE (6,1116)                                                      MAI 3510
0324     1116 FORMAT (1H0///12H SFERE VIVE //)                                    MAI 3520
0325          DO 1111 J=1,NS                                                      MAI 3530
0326     1111 WRITE (6,1112) J,(TP1(K,J,N),K=1,N1P1)                              MAI 3540
0327     1112 FORMAT (1H0,I5,10F10.3)                                             MAI 3550
0328          IF(N2)1109,1109,1234
0329     1234 CONTINUE
```

```
              WRITE (6,1118)
         1118 FORMAT (1H0///14H SFERE INERTI //)
              DO 1121 J=1,NS
         1121 WRITE (6,1112) J,(TP2(K,J,N),K=1,N2)
         1109 CONTINUE
         1011 CONTINUE
              CALL BARRE
              DO 12 I=1,IMAX
              AL12(I)=AL1(I)+AB1(I)
              EP1(I)=BE1(I-1)+BE1(I   )+AL12(I)*VOL1(I)+AL12(I-1)*VOL2(I)
              AL22(I)=AL2(I)+AB2(I)
              EP2(I)=BE2(I-1)+BE2(I)+AL22(I)*VOL1(I)+AL22(I-1)*VOL2(I)
              SRIT=0.
              IF (NRIT)81,81,82
           82 CONTINUE
              DO 73 K=1,NRIT
           73 SRIT=SRIT+DL(K)*C(K,I)
           81 CONTINUE
              TN1(I)=SRIT*(VOL1(I)+VOL2(I))+DER1(I)*P1(I)+SORM(I)
           12 TN2(I)=DER2(I)*P2(I)
              CALL FLUSSI
              PINT=PINT+PM2*DELT
              DO 30 I=2,IMAX
              DO 74 K=1,NRIT
           74 C(K,I)=C(K,I)-DLDT(K)*C(K,I)+DETA(K)*(SFI(I)*P2(I)+SFI1(I)*P1(I))
           30 CONTINUE
              DO 75 K=1,NRIT
           75 C(K,1)=C(K,2)
              IF (KTE)120,120,121
          121 CALL TEST
          120 CONTINUE
           15 CONTINUE
              CALL STAMPA(IS1)
           14 CONTINUE
              CALL STAMPA(IS2)
           13 CONTINUE
              KST=KST+6
              GO TO 1000
          106 CALL STAMPA(2)
              IF (LAST)110,110,9000
         9000 STOP
              END
```

```
0001          SUBROUTINE MAT
0002          REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2
0003          COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)
0004          DIMENSION SORD(100)
0005          COMMON/CDAT/DATA(3500)
0006          COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,
             1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,              SPRG,DAP
             2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
             3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),V
             4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)
             5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),
             6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),
             8X(100),             VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10
             90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)
             A,BI1(100),BI2(100),EP1(100),EP2(100),TO,            DER1(100),D
             BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100
             C),CTN(12,4,10),D1I(10),SRI(10),ALAN  ,SF1I(10),WI(10),D2I(10),SAI(
             D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)
             E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)
0007          DO 1 M=1,NREG
0008          ID=I2(M)-1
0009          IS=I1(M)
0010          D1M=D1(M)
0011          D2M=D2(M)
0012          SRM=SR(M)
0013          SFM=SF(M)*ALAN
0014          SAM=SA(M)
0015          SPRM=SPR(M)
0016          SMMPF = SMPF(M)
0017          SMMPT = SMPT(M)
0018          SORR=SOR(M)
0019          SF1M=SF1(M)*ALAN
0020          AEQUIM=AEQUI(M)
0021          ANUM=ANU(M)*ALAN
0022          PM=P(M)
        C
        C
0023          DO 2 I=IS,ID
0024          SORD(I)=SORR
0025          AL1(I)=SRM+D1M*BU+1.0/(WM*DELT)-SF1M*(1.0-SBETA)+SMMPF
0026          AL2(I)=SAM+SPRM+D2M*BU+1./(VM*DELT)+SMMPT
0027          BL1(I)=SFM*(1.0-SBETA)
0028          BL2(I)=PM*SRM
0029          DEM1(I)=1./(WM*DELT)
0030          DEM2(I)=1./(VM*DELT)
0031          TN2(I)=SFM
0032          TN1(I)=SF1M
0033          BE1(I)=D1M*BE(I)
0034          BE2(I)=D2M*BE(I)
0035          IF(SFM-0.1E-10)2,2,4
0036        4 EQUI1(I)=SF1M*AEQUIM/ANUM
0037          EQUI2(I)=SFM*AEQUIM/ANUM
0038        2 CONTINUE
0039        1 CONTINUE
        C
0040          DO 3I=2,IM1
0041          EP1(I)=BE1(I-1)+BE1(I)+AL1(I)*VOL1(I)+AL1(I-1)*VOL2(I)
0042          BI1(I)=BL1(I)*VOL1(I)+BL1(I-1)*VOL2(I)
0043          BI2(I)=BL2(I)*VOL1(I)+BL2(I-1)*VOL2(I)
0044          DER1(I)=DEM1(I)*VOL1(I)+DEM1(I-1)*VOL2(I)
0045          DER2(I)=DEM2(I)*VOL1(I)+DEM2(I-1)*VOL2(I)
0046          SORM(I)=SORD(I)*VOL1(I)+SORD(I-1)*VOL2(I)
0047          SFI1(I)=(TN1(I)*VOL1(I)+TN1(I-1)*VOL2(I))/(VOL1(I)+VOL2(I))
```

```
      SFI(I)=(TN2(I)*VOL1(I)+TN2(I-1)*VOL2(I))/(VOL1(I)+VOL2(I))        MAT 640
    3 CONTINUE                                                          MAT 650
      RETURN                                                            MAT 660
      END                                                               MAT 670
```

```
0001           SUBROUTINE STAMPA(IST)
         C     STAM
0002           REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2
0003           COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)
0004           COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,
              1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,               SPRG,DAP
              2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
              3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),V
              4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)
              5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),
              6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),
              8X(100),             VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10
              90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)
              A,BI1(100),BI2(100),EP1(100),EP2(100),TO,              DER1(100),D
              BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100
              C),CTN(12,4,10),DII(10),SRI(10),ALAN  ,SF1I(10),WI(10),D2I(10),SAI(
              D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)
              E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)
0005           COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10)
              1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1
0006           COMMON/CDAT/DATA(3500)
0007           DIMENSION  P1N(100),P2N(100)
0008           GO TO (10,20,30),IST
0009        10 DP=(PM2-PMPT)/DELT
0010           PER=(PM2+PMPT)/(DP*2.)
0011           WRITE (6,1)TO,PM1,PM2,PER
0012         1 FORMAT (1H0////,4X,4HTO =,F10.5,4X,5HPM1 =,E12.5,4X,5HPM2 =,E12.5,
              14X,5HPER =,E12.5)
0013           GO TO 40
0014        20 DP=(PM2-PMPT)/DELT
0015           PER=(PM2+PMPT)/(DP*2.)
0016           WRITE (6,2)TO,IT,PER,PINT
0017         2 FORMAT (1H0////////,4X,4HTO =,F10.5,3X,4HIT =,I6,4X,5HPER =,E12.5,
              14X,6HPINT =,E12.5)
0018           WRITE (6,3)
0019         3 FORMAT (1H ///,15X,1HR,14X,2HP1,14X,2HP2,14X,3HP1N,13X,3HP2N,//)
0020           CALL RENORM (FN)
0021           DO 200 I= 1,IMAX
0022           P1N(I) = P1(I) * FN
0023       200 P2N(I) = P2(I) * FN
0024           WRITE (6,4)(I,X(I),P1(I),P2(I),P1N(I),P2N(I),I=1,IMAX)
0025         4 FORMAT (1H ,I5,5E16.5)
0026           WRITE (6,5)PM1,PM2
0027         5 FORMAT (1H0,10X,11HVALORI MEDI,2E16.5)
0028           IF (NRIT)40,40,21
0029        21 CONTINUE
0030           WRITE (6,9)
0031         9 FORMAT (1H ///,14X,2HC1,14X,2HC2,14X,2HC3,14X,2HC4,14X,2HC5,14X,2H
              1C6,//)
0032           DO 11 I=1,IMAX
0033        11 WRITE (6,12)I,(C(K,I),K=1,6)
0034        12 FORMAT (I5,6E16.5)
0035           IF (NRIT-6)100,100,101
0036       101 WRITE (6,102)
0037       102 FORMAT (1H ///,14X,2HC7,14X,2HC8,14X,2HC9,14X,3HC10,//)
0038           DO 111 I=1,IMAX
0039       111 WRITE (6,12)I,(C(K,I),K=7,NRIT)
0040       100 CONTINUE
0041           GO TO 40
0042        30 DP=(PM2-PMPT)/DELT
0043           PER=(PM2+PMPT)/(DP*2.)
0044           DO 8 M=1,NREG
0045           ID=I2(M)-1
```

```
0046           IS=I1(M)+1                                                STA  640
0047           VOLO=6.2832*VOL1(IS-1)                                    STA  650
0048           FL1=P1(IS-1)*VOLO                                         STA  660
0049           FL2=P2(IS-1)*VOLO                                         STA  670
0050           DO 50 I=IS,ID                                             STA  680
0051           FL1=FL1+P1(I)*VOL(I)                                      STA  690
0052           FL2=FL2+P2(I)*VOL(I)                                      STA  700
0053        50 CONTINUE                                                  STA  710
0054           FLM1(M)=(FL1+P1(ID+1)*6.2832*VOL2(ID+1))/VR(M)            STA  720
0055           FLM2(M)=(FL2+P2(ID+1)*6.2832*VOL2(ID+1))/VR(M)            STA  730
0056         8 SAV(M)=(AB2(ID)+SMPT(M))/DATA(76)                         STA  740
0057           WRITE (6,1)TO,PM1,PM2,PER                                 STA  750
0058           WRITE (6,6)SAV,FLM1,FLM2                                  STA  760
0059         6 FORMAT (13HOVELENI BARRE/10E12.4/9X,4HFLM1/10E12.4/9X,4HFLM2/10E12STA  770
            1.4)                                                         STA  780
0060        40 CONTINUE                                                  STA  790
0061           RETURN                                                    STA  800
0062           END                                                       STA  810
```

```
0001         SUBROUTINE INTEGR(IC)
        C
0002         COMMON/COMT/CALU,DZ,SE ,SC,RO,PALN1,RAVI,PALN2,RAIN,CQZ,DETT,RES1(
            110),RES2(10),CPT1(10),CPT2(10),VOS1(10),VOS2(10),PZO1(10),PZO2(10)
            2,AI1(10),BI1(10),CI1(10),DI1(10),TN1(10),AI2(10),BI2(10),CI2(10),D
            3I2(10),TN2(10),FF1(10),FM1(10),FF2(10),FM2(10),AIC,CIC
0003         COMMON/CDAT/DATA(3500)
0004         COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10)
            1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1
0005         DIMENSION TMAX(10),TMAXI(10)
        C
0006         FNS = FLOAT (NS)
        C
0007         DO 1  J=1,N1
0008         TP1(J,1,IC) = TP1(J,2,IC) - TP1(N1P1,2,IC) + TP1(N1P1,1,IC)
0009         TMAX(J)=0.0
0010         DO 2  I=1,NS
0011       2 TMAX(J)=TMAX(J)+TP1(J,I,IC)
0012       1 TMAX(J) = TMAX(J) / FNS
        C
0013         DO 3  J=1,N2
0014         TMAXI(J)=0.0
0015         TP2(J,1,IC) = TP2(J,2,IC) - TP1(N1P1,2,IC) + TP1(N1P1,1,IC)
0016         DO 4  I=1,NS
0017       4 TMAXI(J)=TMAXI(J)+TP2(J,I,IC)
0018       3 TMAXI (J) = TMAXI (J) / FNS
        C
0019         TMUR = 0.0
0020         FFD = 0.0
0021         DO 5 J=1,N1
0022         TMUR = TMUR+TMAX(J)*FF1(J)*PALN1
0023       5 FFD  = FFD+FF1(J)*PALN1
0024         DO 6  J=1,N2
0025         TMUR = TMUR+TMAXI(J)*FF2(J)*PALN2
0026       6 FFD  = FFD+FF2(J)*PALN2
        C
0027         TMED(IC,1)= TMUR/FFD
        C
        C
0028         TMOD =0.0
0029         FMD  =0.0
0030         DO 7 J=1,N1
0031         TMOD = TMOD + TMAX(J)*FM1(J)*PALN1
0032       7 FMD  = FMD + FM1(J)*PALN1
0033         DO 8  J=1,N2
0034         TMOD = TMOD+TMAXI(J)*FM2(J)*PALN2
0035       8 FMD =  FMD + FM2(J)*PALN2
        C
0036         TMED(IC,2) = TMOD/FMD
        C
0037         TMGAS =0.0
0038         DO 9 I = 1,NS
0039       9 TMGAS =TMGAS+TP1(N1P1,I,IC)
0040         TMED(IC,3) = TMGAS / FNS
        C
0041         RETURN
0042         END
```

```
0001           SUBROUTINE CANPAL(FVI,ICAN,TEM,P)
         C
0002           REAL*8 ALFA,BETA
0003           COMMON/COMT/CALU,DZ,SE ,SC,RO,PALN1,RAVI,PALN2,RAIN,CQZ,DETT,RES1(
              110),RES2(10),CPT1(10),CPT2(10),VOS1(10),VOS2(10),PZO1(10),PZO2(10)
              2,AI1(10),BI1(10),CI1(10),DI1(10),TN1(10),AI2(10),BI2(10),CI2(10),D
              3I2(10),TN2(10),FF1(10),FM1(10),FF2(10),FM2(10),AIC,CIC
0004           COMMON/CDAT/DATA(3500)
0005           COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10)
              1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1
0006           DIMENSION FAS(20,10),ALFA1(10),BETA1(10),ALFA2(10),BETA2(10),POT1(
              121),POT2(21)
         C
0007           IC=ICAN
0008           RAVI = DATA (IC + 1380)
0009           RAIN = DATA (IC + 1390 )
0010           NC=(IC-1)*20
0011           T=TEM
0012           CALL VINIZ(1,IC,T,TPI,WS)
0013           TP1(N1P1,1,IC)=TPI
0014           NVI=FVI+0.0001
0015           IF (NVI-1) 200,100,100
0016       100 DO 1 I=2,NS
0017           POT1(I)=P*RAVI*FAS(I,IC)/PALN1
0018           POT2(I)=P*RAIN*FAS(I,IC)/PALN2
         C
0019           DO 2 J=1,N1
0020           BI1(J)=-(AI1(J)+CI1(J)+DI1(J))
0021         2 TN1(J)=POT1(I)*PZO1(J)+DI1(J)*TP1(J,I,IC)
0022           DO 3 J=1,N2
0023           BI2(J)=-(AI2(J)+CI2(J)+DI2(J))
0024         3 TN2(J)=POT2(I)*PZO2(J)+DI2(J)*TP2(J,I,IC)
         C
0025           ALFA1(1)=-TN1(1)/BI1(1)
0026           BETA1(1)=-CI1(1)/BI1(1)
0027           DO 4 J=2,N1M1
0028           DENOM=AI1(J)*BETA1(J-1)+BI1(J)
0029           ALFA1(J)=-(TN1(J)+AI1(J)*ALFA1(J-1))/DENOM
0030         4 BETA1(J)=-CI1(J)/DENOM
         C
0031           ALFA2(1)=-TN2(1)/BI2(1)
0032           BETA2(1)=-CI2(1)/BI2(1)
0033           DO 5 J=2,N2M1
0034           DENOM=AI2(J)*BETA2(J-1)+BI2(J)
0035           ALFA2(J)=-(TN2(J)+AI2(J)*ALFA2(J-1))/DENOM
0036         5 BETA2(J)=-CI2(J)/DENOM
         C
0037           DEM1=BI1(N1)+AI1(N1)*BETA1(N1M1)
0038           ALCO1=-(ALFA1(N1M1)*AI1(N1)+DI1(N1)*TP1(N1,I,IC)+POT1(I)*PZO1(N1))
              1/DEM1
0039           BECO1=-CI1(N1)/DEM1-1.0
         C
0040           DEM2=BI2(N2)+AI2(N2)*BETA2(N2M1)
0041           ALCO2=-(ALFA2(N2M1)*AI2(N2)+DI2(N2)*TP2(N2,I,IC)+POT2(I)*PZO2(N2))
              1/DEM2
0042           BECO2=-CI2(N2)/DEM2-1.0
         C
0043           TP1(N1P1,I,IC)=-(AIC*ALCO1+CIC*ALCO2+SC*WS*TP1(N1P1,I-1,IC)+DETT*T
              1P1(N1P1,I,IC))/(AIC*BECO1+CIC*BECO2-SC*WS-DETT)
         C
0044           TN1(N1)=POT1(I)*PZO1(N1)+DI1(N1)*TP1(N1,I,IC)+CI1(N1)*TP1(N1P1,I,I
              1C)
0045           ALFA1(N1)=-(ALFA1(N1M1)*AI1(N1)+TN1(N1))/DEM1
```

```
              C
 0046               TN2(N2)=POT2(I)*PZO2(N2)+DI2(N2)*TP2(N2,I,IC)+CI2(N2)*TP1(N1P1,I,I
                   1C)
 0047               ALFA2(N2)=-(ALFA2(N2M1)*AI2(N2)+TN2(N2))/DEM2
              C
 0048               TP1(N1,I,IC)=ALFA1(N1)
 0049               DO 6 K=1,N1M1
 0050               J=N1-K
 0051             6 TP1(J,I,IC)=ALFA1(J)+BETA1(J)*TP1(J+1,I,IC)
              C
 0052               TP2(N2,I,IC)=ALFA2(N2)
 0053               DO 7 K=1,N2M1
 0054               J=N2-K
 0055             7 TP2(J,I,IC)=ALFA2(J)+BETA2(J)*TP2(J+1,I,IC)
 0056             1 CONTINUE
 0057               CALL INTEGR(IC)
 0058               GO TO 80
              C
              C     CALCOLO EQUILIBRIO
              C
              C     SFERE VIVE
              C
 0059           200 CONTINUE
 0060               SIFAS=0.0
 0061               DO 220 I=2,NS
 0062               IFAS=I+NC
 0063           220 SIFAS=SIFAS+DATA(IFAS+1999)
 0064               DO 221 I=2,NS
 0065               IFAS=I+NC
 0066           221 FAS(I,IC)=DATA(IFAS+1999)/SIFAS
 0067               DO 201 I=2,NS
 0068               POT1(I)=P*RAVI*FAS(I,IC)/PALN1
 0069               POT2(I)=P*RAIN*FAS(I,IC)/PALN2
 0070               DO 202 J=1,N1
 0071               BI1(J)=-(AI1(J)+CI1(J))
 0072           202 TN1(J)=POT1(I)*PZO1(J)
 0073               DO 203 J=1,N2
 0074               BI2(J)=-(AI2(J)+CI2(J))
 0075           203 TN2(J)=POT2(I)*PZO2(J)
              C
 0076               ALFA1(1)=-TN1(1)/BI1(1)
 0077               BETA1(1)=-CI1(1)/BI1(1)
 0078               DO 204 J=2,N1M1
 0079               DENOM=AI1(J)*BETA1(J-1)+BI1(J)
 0080               ALFA1(J)=-(TN1(J)+AI1(J)*ALFA1(J-1))/DENOM
 0081           204 BETA1(J)=-CI1(J)/DENOM
              C
 0082               ALFA2(1)=-TN2(1)/BI2(1)
 0083               BETA2(1)=-CI2(1)/BI2(1)
 0084               DO 205 J=2,N2M1
 0085               DENOM=AI2(J)*BETA2(J-1)+BI2(J)
 0086               ALFA2(J)=-(TN2(J)+AI2(J)*ALFA2(J-1))/DENOM
 0087           205 BETA2(J)=-CI2(J)/DENOM
              C
 0088               DEM1=BI1(N1)+AI1(N1)*BETA1(N1M1)
 0089               ALCO1=-(ALFA1(N1M1)*AI1(N1)+POT1(I)*PZO1(N1))/DEM1
 0090               BECO1=-CI1(N1)/DEM1-1.0
              C
 0091               DEM2=BI2(N2)+AI2(N2)*BETA2(N2M1)
 0092               ALCO2=-(ALFA2(N2M1)*AI2(N2)+POT2(I)*PZO2(N2))/DEM2
 0093               BECO2=-CI2(N2)/DEM2-1.0
              C
 0094               TP1(N1P1,I,IC)=-(AIC*ALCO1+CIC*ALCO2+SC*WS*TP1(N1P1,I-1,IC))/(AIC*
```

```
                 1BECO1+CIC*BECO2-SC*WS)
          C
0095              TN1(N1)=POT1(I)*PZO1(N1)+CI1(N1)*TP1(N1P1,I,IC)
0096              ALFA1(N1)=-(ALFA1(N1M1)*AI1(N1)+TN1(N1))/DEM1
          C
0097              TN2(N2)=POT2(I)*PZO2(N2)+CI2(N2)*TP1(N1P1,I,IC)
0098              ALFA2(N2)=-(ALFA2(N2M1)*AI2(N2)+TN2(N2))/DEM2
          C
          C
0099              TP1(N1,I,IC)=ALFA1(N1)
0100              DO 206 K=1,N1M1
0101              J=N1-K
0102          206 TP1(J,I,IC)=ALFA1(J)+BETA1(J)*TP1(J+1,I,IC)
          C
0103              TP2(N2,I,IC)=ALFA2(N2)
0104              DO 207 K=1,N2M1
0105              J=N2-K
0106          207 TP2(J,I,IC)=ALFA2(J)+BETA2(J)*TP2(J+1,I,IC)
0107          201 CONTINUE
          C
          C
0108              CALL INTEGR(IC)
          C
0109           80 RETURN
0110              END
```

```
FORTRAN IV G LEVEL 1, MOD 3          DCAN          DATE = 69111          15/41/30          PAGE 0001

0001            SUBROUTINE DCAN(DT)
          C
0002            COMMON/COMT/CALU,DZ,SE ,SC,RO,PALN1,RAVI,PALN2,RAIN,CQZ,DETT,RES1(
               110),RES2(10),CPT1(10),CPT2(10),VOS1(10),VOS2(10),PZO1(10),PZO2(10)
               2,AI1(10),BI1(10),CI1(10),DI1(10),TN1(10),AI2(10),BI2(10),CI2(10),D
               3I2(10),TN2(10),FF1(10),FM1(10),FF2(10),FM2(10),AIC,CIC
0003            COMMON/CDAT/DATA(3500)
0004            COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10)
               1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1
          C
0005            NSV=DATA(2501)+0.0001
0006            NS=NSV+1
0007            CALU=DATA(2502)
0008            DZ=CALU/DATA(2501)
0009            SE =DATA(2503)
0010            SC=DATA(2504)
0011            RO=DATA(2505)
          C
0012            N1=DATA(2506)
0013            N1M1=N1-1
0014            N1P1 = N1+1
0015            PALN1=DATA(2507)
          C
0016            N2=DATA(2509)
0017            N2M1=N2-1
0018            N2P1 = N2+1
0019            PALN2=DATA(2510)
0020            RAPSE=DATA(2512)
0021            NREG=DATA(5)+0.0001
          C
0022            SPZ1 = 0.0
0023            DO 30 J=1,N1
0024         30 SPZ1 =SPZ1+DATA(J+2830)
0025            SPZ2 = 0.0
0026            DO 31 J=1,N2
0027         31 SPZ2=SPZ2+DATA(J+2930)
          C
0028            DO 10 J=1,N1
0029            RES1(J)=DATA(J+2800)
0030            CPT1(J)=DATA(J+2810)
0031            VOS1(J)=DATA(J+2820)
0032            PZO1(J)=DATA(J+2830)/SPZ1
0033            FF1(J)=DATA(J+2840)
0034            FM1(J)=DATA(J+2850)
0035         10 CONTINUE
          C
0036            DO 20 J=1,N2
0037            RES2(J)=DATA(J+2900)
0038            CPT2(J)=DATA(J+2910)
0039            VOS2(J)=DATA(J+2920)
0040            PZO2(J)=DATA(J+2930)/SPZ2
0041            FF2(J)=DATA(J+2940)
0042            FM2(J)=DATA(J+2950)
0043         20 CONTINUE
          C
0044            CI1(1)=1.0/RES1(1)
0045            DI1(1)=CPT1(1)/DT
0046            DO 1 J=2,N1
0047            AI1(J)=1.0/RES1(J-1)
0048            CI1(J)=1.0/RES1(J)
0049          1 DI1(J)=CPT1(J)/DT
0050            DETT=SC*RO*SE*RAPSE*DZ/DT
          C
```

```
      CI2(1)=1.0/RES2(1)
      DI2(1)=CPT2(1)/DT
      DO 2 J=2,N2
      AI2(J)=1.0/RES2(J-1)
      CI2(J)=1.0/RES2(J)
    2 DI2(J)=CPT2(J)/DT
C
      DO 77 M=1,NREG
   77 SEZ(M)=SE/VR(M)
      WRITE(6,100) (SEZ(M),M=1,NREG)
  100 FORMAT(///10X,'VERHAELTNIS DER QUERSCHNITTE KANAL/REGION'///
     110E12.4)
      AIC=PALN1/RES1(N1)
      CIC=PALN2/RES2(N2)
      RETURN
      END
```

```
0001          SUBROUTINE VINIZ(JJ,IC,T,TPI,WS)
        C     VINIZ
0002          COMMON/COMT/CALU,DZ,SE ,SC,RO,PALN1,RAVI,PALN2,RAIN,CQZ,DETT,RES1(
             110),RES2(10),CPT1(10),CPT2(10),VOS1(10),VOS2(10),PZO1(10),PZO2(10)
             2,AI1(10),BI1(10),CI1(10),DI1(10),TN1(10),AI2(10),BI2(10),CI2(10),D
             3I2(10),TN2(10),FF1(10),FM1(10),FF2(10),FM2(10),AIC,CIC
0003          COMMON/CDAT/DATA(3500)
0004          COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10)
             1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1
0005          IC=IC
0006          ICC=30*(IC-1)
0007          IF (DATA(ICC+2521)-0.0001)9,9,15
0008       15 IF (T-1.0E-07)50,50,51
0009       50 TPI=DATA(ICC+2521)
0010          GO TO 16
0011       51 TPI=DATA(ICC+2521)+DATA(ICC+2522)+DATA(ICC+2523)*T
0012          GO TO 16
0013        9 IAA=10*(IC-1)
0014          DO 1 I=1,10
0015          IPP=IAA+I
0016          TAV=DATA(IPP+3101)
0017          IF (T-TAV)2,3,1
0018        2 TRAV=DATA(IPP+3001)
0019          TRDI=DATA(IPP+3000)
0020          TDI=DATA(IPP+3100)
0021          TPI=TRDI+(T-TDI)*(TRAV-TRDI)/(TAV-TDI)
0022          GO TO 4
0023        3 TRAV=DATA(IPP+3001)
0024          TPI=TRAV
0025          GO TO 4
0026        1 CONTINUE
0027          TPI=TRAV
0028        4 CONTINUE
0029       16 IF (DATA(ICC+2524)-1.0E-06)11,11,18
0030       18 IF (T-1.0E-10)52,52,53
0031       52 WS=DATA(ICC+2524)
0032          GO TO 12
0033       53 WS=DATA(ICC+2524)+DATA(ICC+2525)+DATA(ICC+2526)*T
0034          GO TO 12
0035       11 IAA=10*(IC-1)
0036          DO 5 I=1,10
0037          IPP=IAA+I
0038          TAV=DATA(IPP+3301)
0039          IF (T-TAV)6,7,5
0040        6 VAV=DATA(IPP+3201)
0041          VDI=DATA(IPP+3200)
0042          TDI=DATA(IPP+3300)
0043          WS=VDI+(T-TDI)*(VAV-VDI)/(TAV-TDI)
0044          GO TO 8
0045        7 VAV=DATA(IPP+3201)
0046          WS=VAV
0047          GO TO 8
0048        5 CONTINUE
0049          WS=VAV
0050        8 CONTINUE
0051       12 CONTINUE
0052          RETURN
0053          END
```

```
FORTRAN IV G LEVEL 1, MOD 3            INIZ            DATE = 69111          15/41/30             PAGE 0001

0001               SUBROUTINE INIZ                                                        INI   10
0002               REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2                                      INI   20
0003               COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)               INI   30
0004               COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,INI   40
                  1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,          SPRG,DAPINI   50
                  2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
                  3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),VINI   70
                  4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)INI   80
                  5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),INI   90
                  6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),   INI  100
                  8X(100),          VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10INI  110
                  9O),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)INI  120
                  A,BI1(100),BI2(100),EP1(100),EP2(100),TO,          DER1(100),DINI  130
                  BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100INI  140
                  C),CTN(12,4,10),D1I(10),SRI(10),ALAN   ,SF1I(10),WI(10),D2I(10),SAI(MAI   1
                  D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)              INI  160
                  E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)             INI  170
0005               COMMON/CDAT/DATA(3500)                                                 INI  180
0006               DO 2 I=1,IMAX                                                          INI  190
0007             2 EP2(I)=BE2(I-1)+BE2(I)+AL2(I)*VOL1(I)+AL2(I-1)*VOL2(I)                INI  200
0008               DO 1 LK=1,IDST                                                         INI  210
0009               DO 7 I=1,IMAX                                                          INI  220
0010               TN1(I)=DER1(I)*P1(I)+SORM(I)                                           INI  230
0011             7 TN2(I)=DER2(I)*P2(I)                                                   INI  240
0012               CALL FLUSSI                                                            INI  250
0013               CALL RENORM(FN)                                                        INI  260
0014               DO 3 I=1,IMAX                                                          INI  270
0015               P2(I)=P2(I)*FN                                                         INI  280
0016             3 P1(I)=P1(I)*FN                                                         INI  290
0017             1 CONTINUE                                                               INI  300
0018               PMPT=FN                                                                INI  310
0019               PM1=PM1*FN                                                             INI  320
0020               PM2=PM2*FN                                                             INI  330
0021            10 CONTINUE                                                               INI  340
0022               IF(NRIT.LE.0) RETURN                                                   INI  350
0023               DO 6 I=1,IMAX                                                          INI  360
0024               DO 11 K=1,NRIT                                                         INI  370
0025            11 C(K,I)=DETA(K)*(SFI(I)*P2(I)+SFI1(I)*P1(I))                           INI  380
0026             6 CONTINUE                                                               INI  390
0027               RETURN                                                                 INI  400
0028               END                                                                    INI  410
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```
0001          SUBROUTINE FLUSSI
        C     FLUS
0002          REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2
0003          COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)
0004          REAL*8 AA1,AA2,BB1,BB2,WL11,WL12,WL21,WL22,W11,W12,W21,W22,WW
0005          DIMENSION AA1(2,100),AA2(2,100),BB1(100),BB2(100)
0006          COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,
             1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,           SPRG,DAP
             2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
             3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),V
             4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)
             5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),
             6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),
             8X(100),             VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10
             90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)
             A,BI1(100),BI2(100),EP1(100),EP2(100),TO,            DER1(100),D
             BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100
             C),CTN(12,4,10),D1I(10),SRI(10),ALAN   ,SF1I(10),WI(10),D2I(10),SAI(
             D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)
             E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)
0007          COMMON/CDAT/DATA(3500)
0008          PMPT=PM2
0009          AA1(1,1)=0.0
0010          AA1(2,1)=0.0
0011          AA2(1,1)=0.0
0012          AA2(2,1)=0.0
0013          BB1(1)=0.0
0014          BB2(1)=0.0
0015          DO 1 I=2,IM1
0016          WL11=EP1(I)-BE1(I-1)*AA1(1,I-1)
0017          WL12=-BI1(I)-BE1(I-1)*AA1(2,I-1)
0018          WL21=-BI2(I)-BE2(I-1)*AA2(1,I-1)
0019          WL22=EP2(I)-BE2(I-1)*AA2(2,I-1)
0020          WW=WL11*WL22-WL12*WL21
0021          W11=WL22/WW
0022          W12=-WL12/WW
0023          W21=-WL21/WW
0024          W22=WL11/WW
0025          AA1(1,I)=W11*BE1(I)
0026          AA1(2,I)=W12*BE2(I)
0027          AA2(1,I)=W21*BE1(I)
0028          AA2(2,I)=W22*BE2(I)
0029          WL11=TN1(I)+BE1(I-1)*BB1(I-1)
0030          WL21=TN2(I)+BE2(I-1)*BB2(I-1)
0031          BB1(I)=W11*WL11+W12*WL21
0032          BB2(I)=W21*WL11+W22*WL21
0033        1 CONTINUE
0034          P1(IM1)=BB1(IM1)
0035          P2(IM1)=BB2(IM1)
0036          PM2=P2(IM1)*VOL(IM1)
0037          PM1=P1(IM1)*VOL(IM1)
0038          I=IM1
0039          DO 2 J=2,NK
0040          I=I-1
0041          P1(I)=AA1(1,I)*P1(I+1)+AA1(2,I)*P2(I+1)+BB1(I)
0042          P2(I)=AA2(1,I)*P1(I+1)+AA2(2,I)*P2(I+1)+BB2(I)
0043          PM2=PM2+P2(I)*VOL(I)
0044        2 PM1=PM1+P1(I)*VOL(I)
0045          PM2=PM2/VOLT
0046          PM1=PM1/VOLT
0047          P1(1)=P1(2)
0048          P2(1)=P2(2)
0049          RETURN
```

```
 0050              END                                              FLU  640
```

```
      SUBROUTINE BARRE
      REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2
      COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)
      COMMON/CDAT/DATA(3500)
      COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,
     1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,           SPRG,DAP
     2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
     3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),V
     4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)
     5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),
     6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),
     8X(100),            VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10
     90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)
     A,BI1(100),BI2(100),EP1(100),EP2(100),TO,          DER1(100),D
     BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100
     C),CTN(12,4,10),D1I(10),SRI(10),ALAN   ,SF1I(10),WI(10),D2I(10),SAI(MAI   1
     D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)
     E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)
      DO 1 M=1,NREG
      IF(KV(M)+10)1,1,10
   10 CONTINUE
      IREG=(M-1)*60
      DO 2 K=1,30
      IPP=IREG+K
      TOAV=DATA(IPP+301)
      IF(TOAV-0.0000001)3,3,4
    3 VEL=DATA(IPP+330)
      KV(M)=-100
      GO TO 5
    4 IF(TO.GE.TOAV) GO TO 2
      VELAV=DATA(IPP+331)
      VELDI=DATA(IPP+330)
      TODI=DATA(IPP+300)
      VEL=VELDI+(VELAV-VELDI)*(TO-TODI)/(TOAV-TODI)
      GO TO 5
    2 CONTINUE
    5 IS=I1(M)
      ID=I2(M)-1
      DO 6 I=IS,ID
      AB1(I)=DATA(75)*VEL
      AB2(I)=DATA(76)*VEL
    6 CONTINUE
    1 CONTINUE
      RETURN
      END
```

```
0001          SUBROUTINE TEST                                                   TE    10
0002          REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2                                 TE    20
0003          COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)          TE    30
0004          COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,TE    40
             1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,           SPRG,DAPTE    50
             2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
             3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),VTE    70
             4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)TE    80
             5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),TE    90
             6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),   TE   100
             8X(100),                VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10TE   110
             90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)TE   120
             A,BI1(100),BI2(100),EP1(100),EP2(100),TO,                DER1(100),DTE   130
             BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100TE   140
             C),CTN(12,4,10),D1I(10),SRI(10),ALAN   ,SF1I(10),WI(10),D2I(10),SAI(MAI   1
             D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)           TE   160
             E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)          TE   170
0005          COMMON/CDAT/DATA(3500)                                            TE   180
0006          COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10) TE   190
             1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1                                 TE   200
0007          KTE=0                                                             TE   210
0008          RETURN                                                            TE   220
0009          END                                                               TE   230
```

```
0001          SUBROUTINE POREG                                                  POR   10
0002          REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2                                 POR   20
0003          COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)          POR   30
0004          COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,POR   40
             1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,         SPRG,DAPPOR   50
             2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
             3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),VPOR   70
             4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)POR   80
             5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),POR   90
             6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),   POR  100
             8X(100),             VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10POR  110
             90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)POR  120
             A,BI1(100),BI2(100),EP1(100),EP2(100),TO,            DER1(100),DPOR  130
             BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100POR  140
             C),CTN(12,4,10),D1I(10),SRI(10),ALAN   ,SF1I(10),WI(10),D2I(10),SAI(MAI  1
             D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)           POR  160
             E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)          POR  170
0005          COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10) POR  180
             1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1                                 POR  190
0006          COMMON/CDAT/DATA(3500)                                            POR  200
0007          DO 1 M=1,NREG                                                     POR  210
0008          SUM=0.0                                                           POR  220
0009          ID=I2(M)-1                                                        POR  230
0010          IS=I1(M)+1                                                        POR  240
0011          SUM=SUM+EQUI1(IS-1)*VOL1(IS-1)*P1(IS-1)+EQUI2(IS-1)*VOL1(IS-1)    POR  250
             1*P2(IS-1)                                                         POR  260
0012          DO 2 I=IS,ID                                                      POR  270
0013          SUM=SUM+(EQUI1(I-1)*VOL2(I)+EQUI1(I)*VOL1(I))*P1(I)+(EQUI2(I-1)   POR  280
             1*VOL2(I)+EQUI2(I)*VOL1(I))*P2(I)                                  POR  290
0014        2 CONTINUE                                                          POR  300
0015          SUM=SUM+EQUI1(ID)   *VOL2(ID+1)*P1(ID+1)+EQUI2(ID)   *VOL2(ID+1)  POR  310
             1*P2(ID+1)                                                         POR  320
0016          POWER(M)=SUM*6.2832*SEZ(M)*DATA(14)                               POR  330
0017        1 CONTINUE                                                          POR  340
0018          RETURN                                                            POR  350
0019          END                                                               POR  360
```

```
0001          SUBROUTINE RENORM(FN)
0002          REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2
0003          COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)
0004          COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,
             1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,             SPRG,DAP
             2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
             3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),V
             4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)
             5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),
             6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),
             8X(100),                 VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10
             90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)
             A,BI1(100),BI2(100),EP1(100),EP2(100),TO,             DER1(100),D
             BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100
             C),CTN(12,4,10),D1I(10),SRI(10),ALAN  ,SF1I(10),WI(10),D2I(10),SAI(MAI
             D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)
             E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)
0005          COMMON /CDAT/ DATA(3500)
0006          SUM=0.0
0007          DO 1 I=2,IMAX
0008          SUM=SUM+(EQUI1(I-1)*VOL2(I)+EQUI1(I)*VOL1(I))*P1(I)+
             1(EQUI2(I-1)*VOL2(I)+EQUI2(I)*VOL1(I))*P2(I)
0009        1 CONTINUE
0010          FN=SI/(SUM*6.2832*DATA(14))
0011          RETURN
0012          END
```

```
      SUBROUTINE AZER
      COMMON/COMT/A(233)
      COMMON/COMN/B(4792)
      COMMON/CONT/C(4268)
      COMMON/DP/D(806)
      DO 1 I=1,233
    1 A(I)=0.0
      DO 2 I=1,4792
    2 B(I)=0.0
      DO 3 I=1,4268
    3 C(I)=0.0
      DO 4 I=1,806
    4 D(I)=0.0
      RETURN
      END
```

```
0001          SUBROUTINE CRITIC
0002          REAL*8 PM1,PM2,PMPT,P1,P2,TN1,TN2
0003          COMMON/DP/PMPT,PM1,PM2,P1(100),P2(100),TN1(100),TN2(100)
0004          COMMON/COMN/KBA,KTE,KBAR,KS,NREG,IDST,ITCR,IT,LF,L1,IMAX,KBI,NRIT,
             1IM1,NK,    SI,REP,SPCR,SBETA,PER,PINT,BU,VOLT,              SPRG,DAP
             2F,DELT,DLD,DLM,SPF1(10),SPT1(10),
             3D1(10),D2(10),SF(10),SR(10),SA(10),SPR(10),SF1(10),SOR(10),W(10),V
             4(10),SP(10),P(10),BETA(10),DL(10),DLDT(10),DETA(10),VIM(10),I1(10)
             5,I2(10),KV(10),FLM1(10),FLM2(10),SAV(10),FLIM2(10),PI(10),COU(10),
             6COR(10),TMUI(10),TMC1I(10),TMC2I(10),TCI(10),ICAN(10),SPRI(10),
             8X(100),           VOL1(100),VOL2(100),VOL(100),BE(100),BE1(10
             90),BE2(100),AL1(100),AL2(100),AL22(100),AB2(100),BL1(100),BL2(100)
             A,BI1(100),BI2(100),EP1(100),EP2(100),TO,           DER1(100),D
             BER2(100),DEM1(100),DEM2(100),SORM(100),SFI(100),SFI1(100),C(10,100
             C),CTN(12,4,10),D1I(10),SRI(10),ALAN  ,SF1I(10),WI(10),D2I(10),SAI(
             D10),SFA(10),VI(10),SMPF(10),SMPT(10),AB1(100),AL12(100)
             E,VM,WM,AEQUI(10),ANU(10),EQUI1(100),EQUI2(100),POWER(10)
0005          COMMON/CONT/TP1(10,21,10),TP2(10,21,10),TMED(10,4),SEZ(10),VR(10)
             1,NS,NSV,N1,N1M1,N1P1,N2,N2M1,N2P1
0006          COMMON/CDAT/DATA(3500)
0007          SPRG=DATA(1611)
0008          DAPF=DATA(1612)
0009          LF=DATA(1613)+0.0001
0010          WRITE (6,204)
0011      204 FORMAT (1HO///,15X,18H RICERCA CRITICITA)
0012          WRITE (6,30)(KV(I),I=1,NREG)
0013       30 FORMAT (1H //////,22H  REGIONI AVVELENATE   ,7I10)
0014          WRITE (6,31)SPRG,DAPF,LF,ITCR
0015       31 FORMAT (1HO///,10X,6HSPRG =E14.5,4X,6HDAPF =E14.5,4X,4HLF =I5,4X,
             16HITCR =I5/////)
0016          WRITE (6,203)
0017      203 FORMAT (1HO///,5X,10HITERAZIONI,14X,3H L ,14X,3HREP,11X,6HVELENO)
0018          L1=0.
0019          SP1=0.
0020          SPCR=0.
0021          ITCI=DATA(15)+0.0001
        C
0022     1000 CONTINUE
0023          L1=L1+1
0024          DO 4 M=1,NREG
0025          KVM=KV(M)
0026          IF (M-KVM)5,5,4
0027        5 SMPF(M)=DATA(75)*SPCR+SPF1(M)
0028          SMPT(M)=DATA(76)*SPCR+SPT1(M)
0029          WRITE(6,210)SMPF(M),SMPT(M),SPF1(M),SPT1(M),SPCR
0030      210 FORMAT(5X,'SMPF=',E12.5,3X,'SMPT=',E12.5,3X,'SPF1=',E12.5,3X,'SPT1
             1=',E12.5,3X,'SPCR=',E12.5)
0031        4 CONTINUE
0032          CALL MAT
0033          DO 6 I=1,IMAX
0034        6 EP2(I)=BE2(I-1)+BE2(I)+AL2(I)*VOL1(I)+AL2(I-1)*VOL2(I)
0035          DO 77 J=1,ITCI
0036          DO 20 I=1,IMAX
0037          TN1(I)=DER1(I)*P1(I)
0038       20 TN2(I)=DER2(I)*P2(I)
0039       77 CALL FLUSSI
0040          CALL RENORM(FN)
0041          DO 12 I=1,IMAX
0042          P1(I)=FN*P1(I)
0043       12 P2(I)=FN*P2(I)
0044          PM1=PM1*FN
0045          PM2=PM2*FN
0046          CALL POREG
```

```
0047             N=0                                                         CRI  610
0048             DO 109 M=1,NREG                                             CRI  620
0049             IF(ICAN(M))109,109,110                                      CRI  630
0050         110 N=N+1                                                       CRI  640
0051             CALL CANPAL(0.0,N,TO,POWER(M))                              CRI  650
0052             MR = M                                                      CRI  660
0053             D1(MR)=D1I(MR)+CTN(1,1,N)*(TMED(N,1)-TMUI(MR))+CTN(1,2,N)*(TMED(N,CRI  670
                12)-TMC1I(MR))+CTN(1,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(1,4,N)*(TMED(CRI  680
                2N,2)-TMC1I(MR))**2                                          CRI  690
0054             SR(MR)=SRI(MR)+CTN(2,1,N)*(TMED(N,1)-TMUI(MR))+CTN(2,2,N)*(TMED(N,CRI  700
                12)-TMC1I(MR))+CTN(2,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(2,4,N)*(TMED(CRI  710
                2N,2)-TMC1I(MR))**2                                          CRI  720
0055             P(MR)=PI(MR)+CTN(3,1,N)*(TMED(N,1)-TMUI(MR))+CTN(3,2,N)*(TMED(N,2)CRI  730
                1-TMC1I(MR))+CTN(3,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(3,4,N)*(TMED(N,CRI  740
                22)-TMC1I(MR))**2                                            CRI  750
0056             SF1 (MR)=SF1I(MR)+CTN(4,1,N)*(TMED(N,1)-TMUI(MR))+CTN(4,2,N)*(TMEDCRI  760
                1(N,2)-TMC1I(MR))+CTN(4,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(4,4,N)*(  CRI  770
                2TMED(N,2)-TMC1I(MR))**2                                     CRI  780
0057             W(MR)=WI(MR)+CTN(5,1,N)*(TMED(N,1)-TMUI(MR))+CTN(5,2,N)*(TMED(N,2)CRI  790
                1-TMC1I(MR))+CTN(5,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(5,4,N)*(TMED(N,CRI  800
                22)-TMC1I(MR))**2                                            CRI  810
0058             D2(MR)=D2I(MR)+CTN(6,1,N)*(TMED(N,1)-TMUI(MR))+CTN(6,2,N)*(TMED(N,
                12)-TMC1I(MR))+CTN(6,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(6,4,N)*(TMED(
                2N,2)-TMC1I(MR))**2
0059             SA(MR)=SAI(MR)+CTN(7,1,N)*(TMED(N,1)-TMUI(MR))+CTN(7,2,N)*(TMED(N,
                12)-TMC1I(MR))+CTN(7,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN(7,4,N)*(TMED(
                2N,2)-TMC1I(MR))**2
0060             SF(MR)=SFA(MR)+CTN( 8,1,N)*(TMED(N,1)-TMUI(MR))+CTN( 8,2,N)*(TMED(
                1N,2)-TMC1I(MR))+CTN( 8,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN( 8,4,N)*(T
                2MED(N,2)-TMC1I(MR))**2
0061             V(MR)=VI(MR)+CTN( 9,1,N)*(TMED(N,1)-TMUI(MR))+CTN( 9,2,N)*(TMED(N,
                12)-TMC1I(MR))+CTN( 9,3,N)*(TMED(N,1)-TMUI(MR))**2+CTN( 9,4,N)*(TME
                2D(N,2)-TMC1I(MR))**2
0062         109 CONTINUE                                                    CRI  970
0063             CALL MAT                                                    CRI  980
0064             DO 69 I=2,IMAX                                              CRI  990
0065             EP2(I)=BE2(I-1)+BE2(I)+AL2(I)*VOL1(I)+AL2(I-1)*VOL2(I)      CRI 1000
0066          69 CONTINUE                                                    CRI 1010
0067             DO 7 L=1,ITCR                                               CRI 1020
0068             REPP=REP                                                    CRI 1030
0069             DO 3 I=2,IMAX                                               CRI 1040
0070             TN1(I)=DER1(I)*P1(I)                                        CRI 1050
0071             TN2(I)=DER2(I)*P2(I)                                        CRI 1060
0072           3 CONTINUE                                                    CRI 1070
0073             PMPT=PM2                                                    CRI 1080
0074             CALL FLUSSI                                                 CRI 1090
0075             DP=(PM2-PMPT)/DELT                                          CRI 1100
0076             REP=(DP*2.0)/(PM2+PMPT)                                     CRI 1110
0077             DREP=(REP-REPP)/REP                                         CRI 1120
0078             DRE=ABS(DREP)                                               CRI 1130
0079             IF(DRE-0.01)16,7,7                                          CRI 1140
0080           7 CONTINUE                                                    CRI 1150
0081          16 CONTINUE                                                    CRI 1160
0082             WRITE(6,2)L1,L,REP,SPCR                                     CRI 1170
0083           2 FORMAT(1H ,2I10,10X,2E16.5)                                 CRI 1180
0084             CALL RENORM(FN)                                             CRI 1190
0085             PM2=PM2*FN                                                  CRI 1200
0086             PMPT=PMPT*FN                                                CRI 1210
0087             DO 18 I=2,IMAX                                              CRI 1220
0088             P1(I)=P1(I)*FN                                              CRI 1230
0089          18 P2(I)=P2(I)*FN                                              CRI 1240
0090             IF(L1-1)14,14,15                                            CRI 1250
0091          14 CONTINUE                                                    CRI 1260
```

```
      SP1=SPCR                                                          CRI 1270
      REP1=REP                                                          CRI 1280
      SPCR = SPRG                                                       CRI 1290
      GOTO 1000                                                         CRI 1300
   15 CONTINUE                                                          CRI 1310
      DAP=ABS(REP)                                                      CRI 1320
      IF(DAPF-DAP)9,10,10                                               CRI 1330
    9 IF(LF-L1)10,10,11                                                 CRI 1340
   11 TG=(SPCR-SP1)/(REP-REP1)                                          CRI 1350
      SP1=SPCR                                                          CRI 1360
      SPCR=SPCR-TG*REP                                                  CRI 1370
      SPCRLO=1.0E+30
      DO 310 M=1,NREG
      KVM=KV(M)
      IF(M-KVM)311,311,310
  311 SPCRLI=-(SR(M)+SPF1(M))/DATA(75)
      IF(ABS(SPCRLI)-SPCRO)313,313,314
  313 SPCRLO=ABS(SPCRLI)
  314 SPCRLI=-(SA(M)+SPT1(M))/DATA(76)
      IF(ABS(SPCRLI)-SPCRLO)315,315,310
  315 SPCRLO=ABS(SPCRLI)
  310 CONTINUE
      IF(SPCR+SPCRLO)316,317,317
  316 SPCR=-SPCRLO
  317 IF(SPCR-SP1)318,319,318
  319 WRITE(6,320)
  320 FORMAT(//' KONVERGENZ KANN NICHT ERREICHT WERDEN')
      STOP
  318 CONTINUE
      REP1=REP                                                          CRI 1380
      GOTO 1000                                                         CRI 1390
   10 CONTINUE                                                          CRI 1400
      IF(NRIT.LE.0) RETURN                                              CRI 1410
      DO 106 I=1,IMAX                                                   CRI 1420
      DO 111 K=1,NRIT                                                   CRI 1430
  111 C(K,I)=DETA(K)*(SFI(I)*P2(I)+SFI1(I)*P1(I))                       CRI 1440
  106 CONTINUE                                                          CRI 1450
      RETURN                                                            CRI 1460
      END                                                               CRI 1470
```

```
     1 TEST  CASE      INPUT  DATA
           1             13
  0.0002      0.0002       0.750E+09  20.0        4.0         6.0
  2.0   -05   20.0        20.0         3.0      100.0         1.0
 2.0
           14            15
  0.5   +03   5.0
           31            36

           41            46
  1.2482 -02  3.1297 -02  1.1704 -01  3.0457 -01  1.13   -00  2.898   -00
           61            65
   1.0        6.0          11.0        15.0        20.0
           73            74
  0.504 +06   1.808  +07
           75            76
  0.271 -23   0.8    -23
           81            86
  1.59        27.09  -4   0.720       2.9     -4  3.0   -11
           87            92
  1.32        29.09  -4              38.2     -4  2.46         1.0
           93            98
  1.59        27.09  -4   0.720       2.9     -4  3.0   -11
           99           104
  1.32        29.09  -4              38.2     -4  2.46         1.0
          105           110
  1.59        27.09  -4   0.720       2.9     -4  3.0   -11
          111           116
  1.32        29.09  -4              38.2     -4  2.46         1.0
          117           122
  1.59        27.09  -4   0.720       2.9     -4  3.0   -11
          123           128
  1.32        29.09  -4              38.2     -4  2.46
          201           220
 -20.        20.        40.        60.        80.        100.
 120.        140.       160.       180.       200.       220.
 240.        260.       280.       300.       320.       340.
 360.        380.
          301           302
             0.000001
          331           332
             -0.8259 +18
          361           362
             0.000001
          391           392
             -0.8259 +18
          421           422
             0.000001
          451           452
             -0.8259 +18
          481           482
                0.000001
          511           512
             -0.8259 +18
          903           903

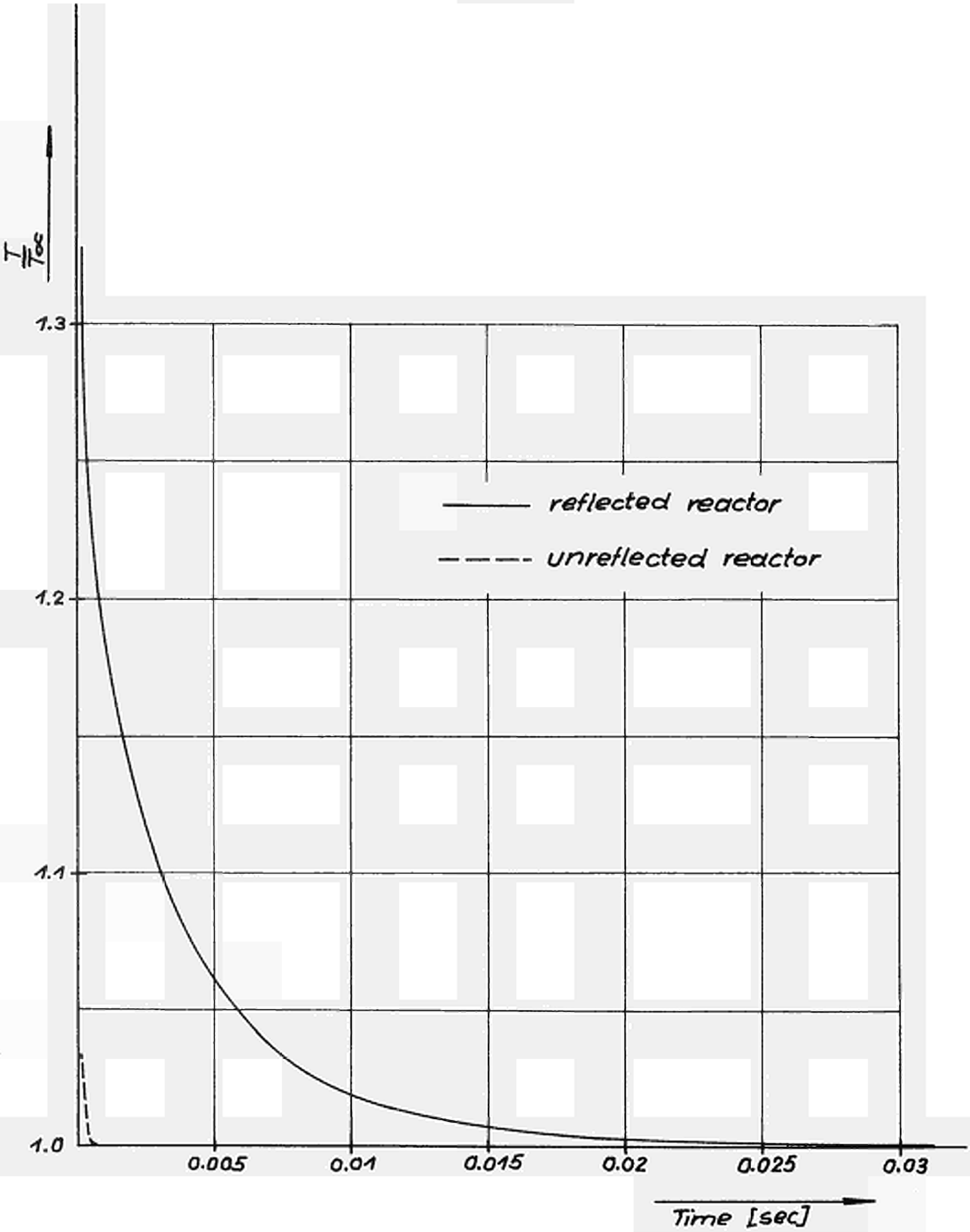
          920           920

          922           922

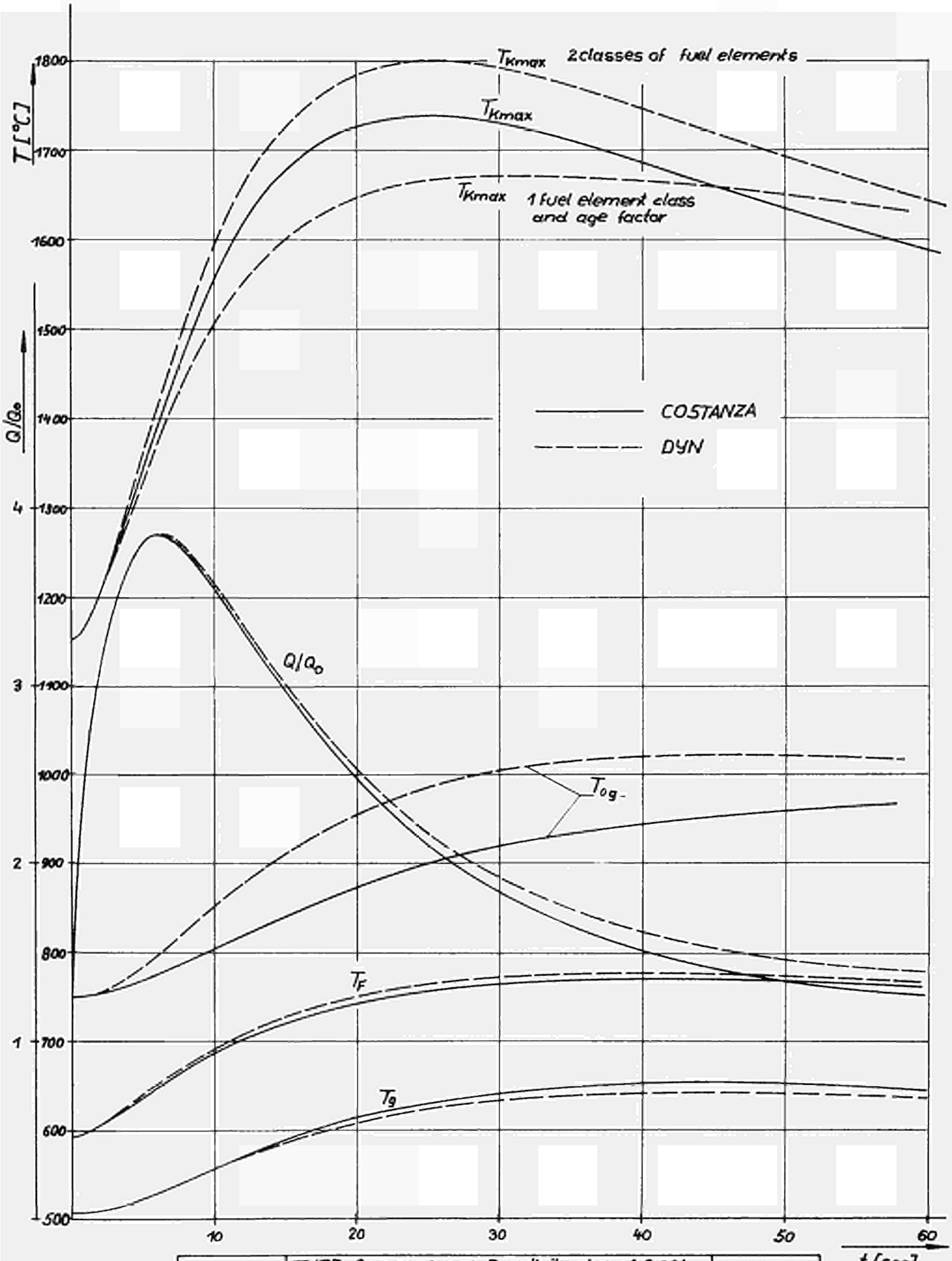
```

61		951		951						
62										
63		968		968						
64										
65		970		970						
66										
67		999		999						
68										
69		1016		1016						
70										
71		1018		1018						
72										
73		1501		1501						
74										
75		1521		1524						
76										
77		1601		1604						
78	1.0		2.0		3.0		4.			
79		1611		1613						
80	1.0	19	0.001		100.					
81		2001		2010						
82	0.060		0.0855		0.106		0.1205	0.128		0.128
83	0.1205		0.106		0.0855		0.060			
84		2021		2030						
85	0.060		0.0855		0.106		0.1205	0.128		0.128
86	0.1205		0.106		0.0855		0.060			
87		2041		2050						
88	0.060		0.0855		0.106		0.1205	0.128		0.128
89	0.1205		0.106		0.0855		0.060			
90		2501		2506						
91	10.0		500.0		0.1	+5	5,205	0.242	-2	6.0
92		2507		2507						
93	0.2713	+4								
94		2509		2510						
95	6.0		.27	+2						
96		2512		2512						
97	0.39									
98		1381		1383						
99	0.979		0.979		0.979					
100		1391		1393						
101	0.021		0.021		0.021					
102		2801		2806						
103	0.157		0.065		0.037		0.0158	0.0098		0.0405
104		2811		2816						
105	11.8		27.8		54.5		90.0	61.2		74.1
106		2821		2826						
107	4.2		9.9		19.4		32.0	21.5		26.0
108		2831		2836						
109	0.0627		0.149		0.29		0.475	0.01		0.0133
110		2841		2846						
111	0.032		0.0755		0.1485		0.244			
112		2851		2856						
113	0.0185		0.044		0.086		0.1415	0.095		0.115
114		2901		2906						
115	0.157		0.065		0.037		0.0158	0.0098		0.0405
116		2911		2916						
117	11.8		27.8		54.5		90.0	61.2		74.1
118		2921		2926						
119	4.2		9.9		19.4		32.0	21.5		26.0
120		2931		2936						

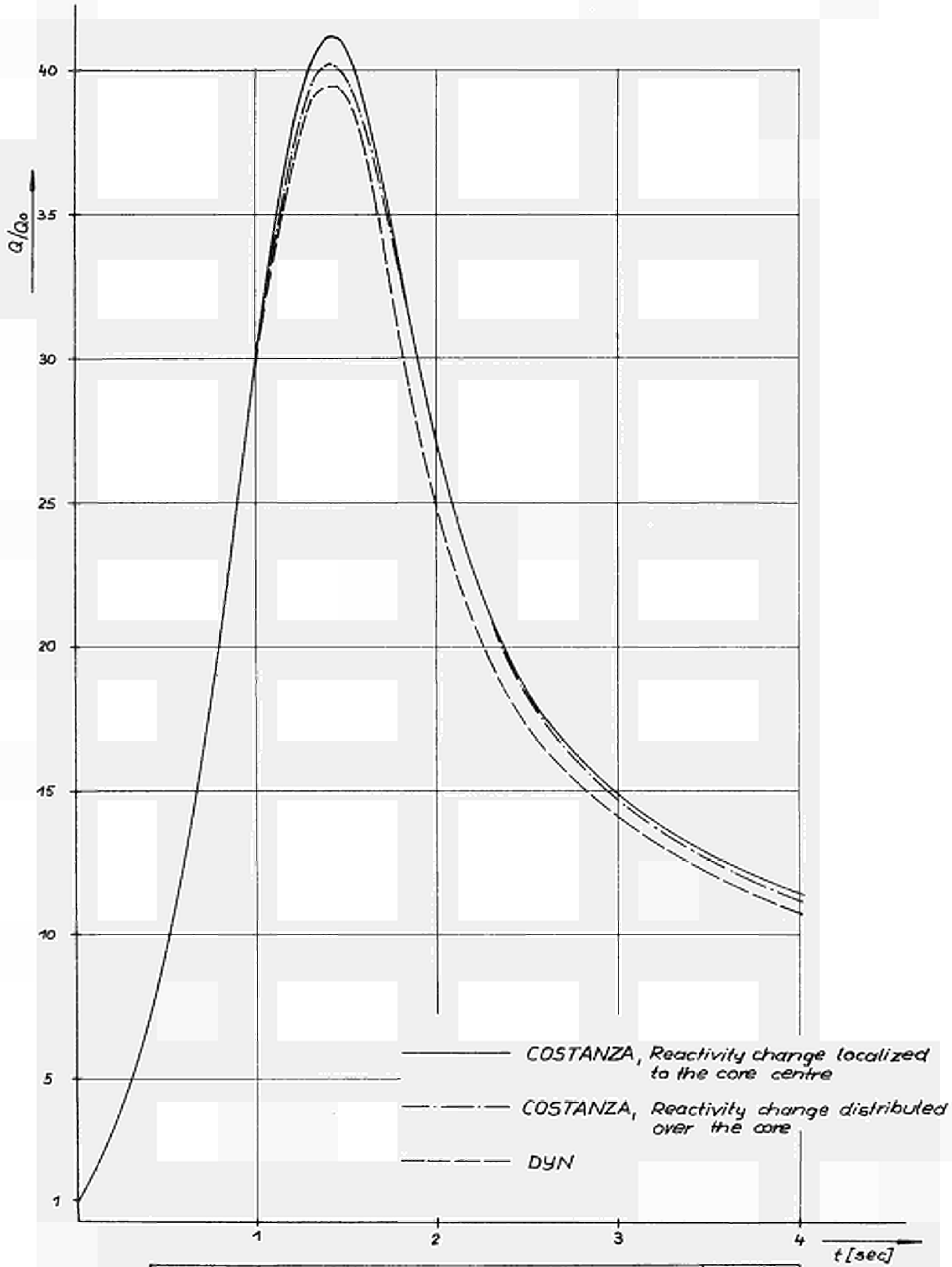
121	0.0627		0.149		0.29	0.475		0.01	0.0133
122		2941		2946					
123	0.032		0.0755		0.1485	0.244			
124		2951		2956					
125	0.0185		0.044		0.086	0.1415		0.095	0.115
126		1401		1403					
127	687.2		620.4		541.0				
128		1411		1413					
129	667.4		603.8		528.1				
130		2521		2524					
131	262.0					1.2	+04		
132		2551		2554					
133	262.0					0.12	&05		
134		2581		2584					
135	262.0					0.12	&05		
136		1857		1857					
137	0.0								
138	-1	1851		1855					
139	10000.		1.		1.	400.	3.		



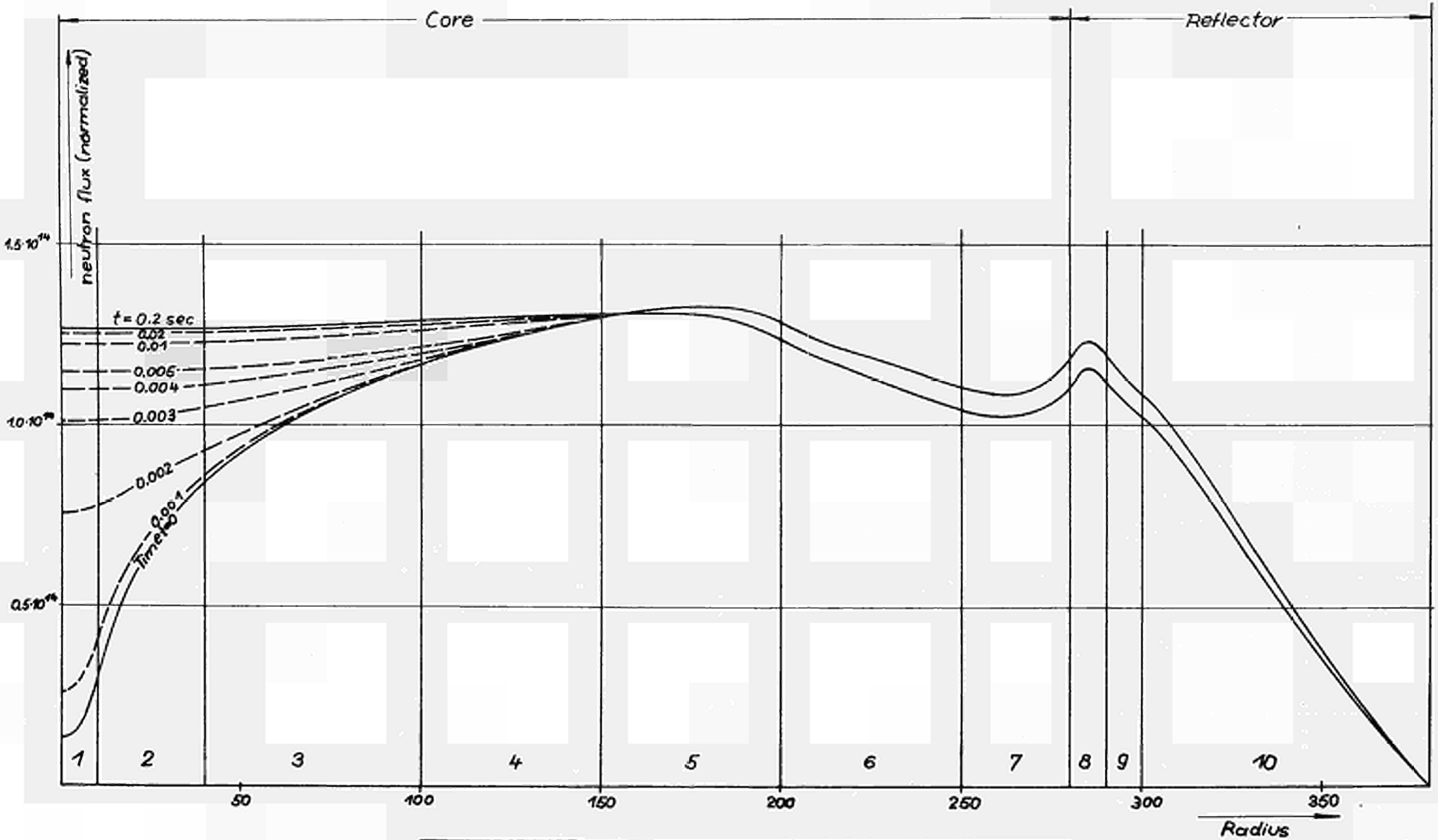
	THTR Time dependance of the reactor period	Nov. 68
		Fig. 1



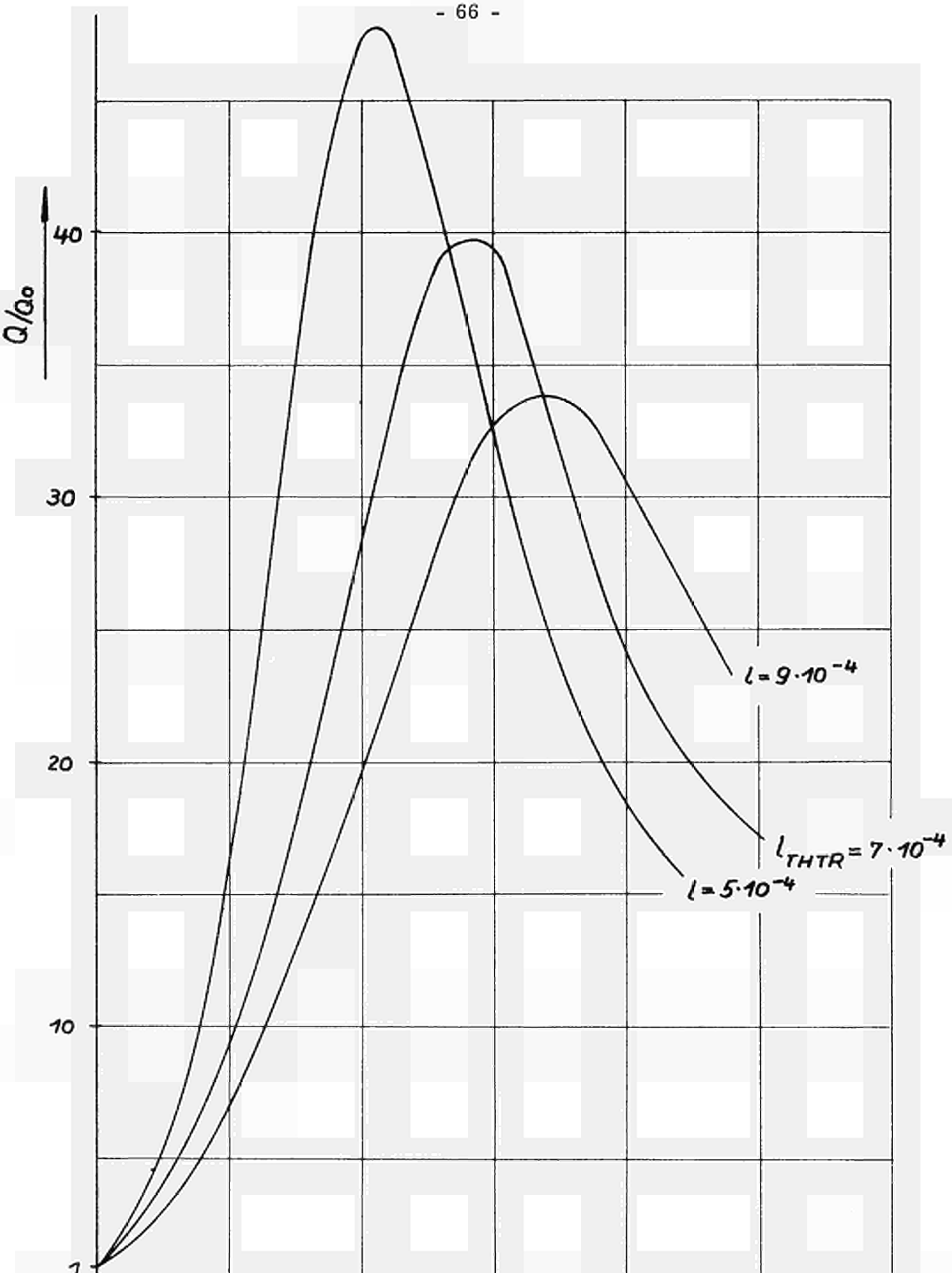
THTR One zone core, Reactivity step of 2.8‰ Comparison between COSTANZA and DYN (The reactivity change in COSTANZA was uniformly distributed over the core)	Nov. 68
	Fig. 2



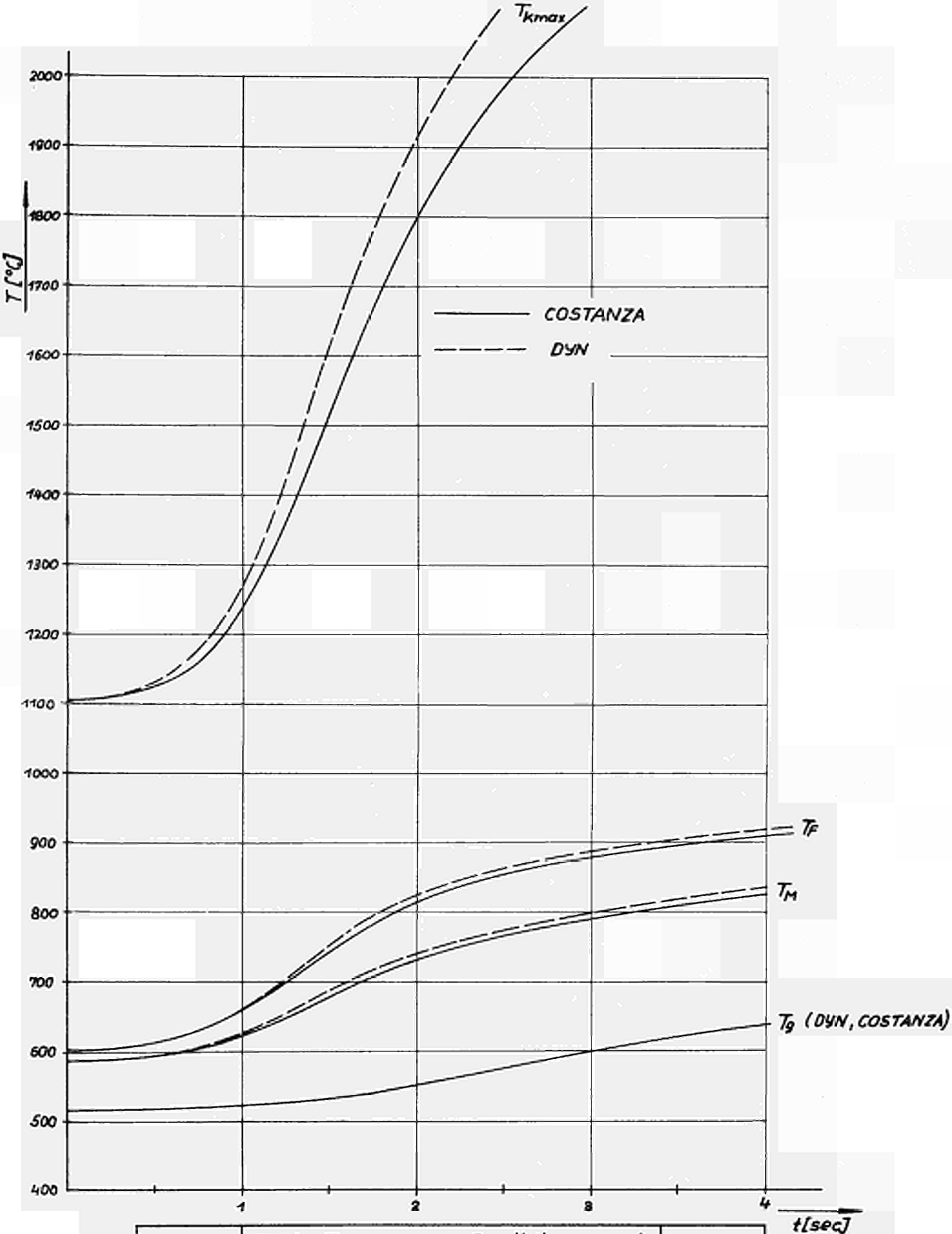
	THTR Two zone core, Reactivity rampe of 6.43 ‰ in 0.002 sec. Comparison between Costanza and DYN	Nov. 68
		Fig. 3



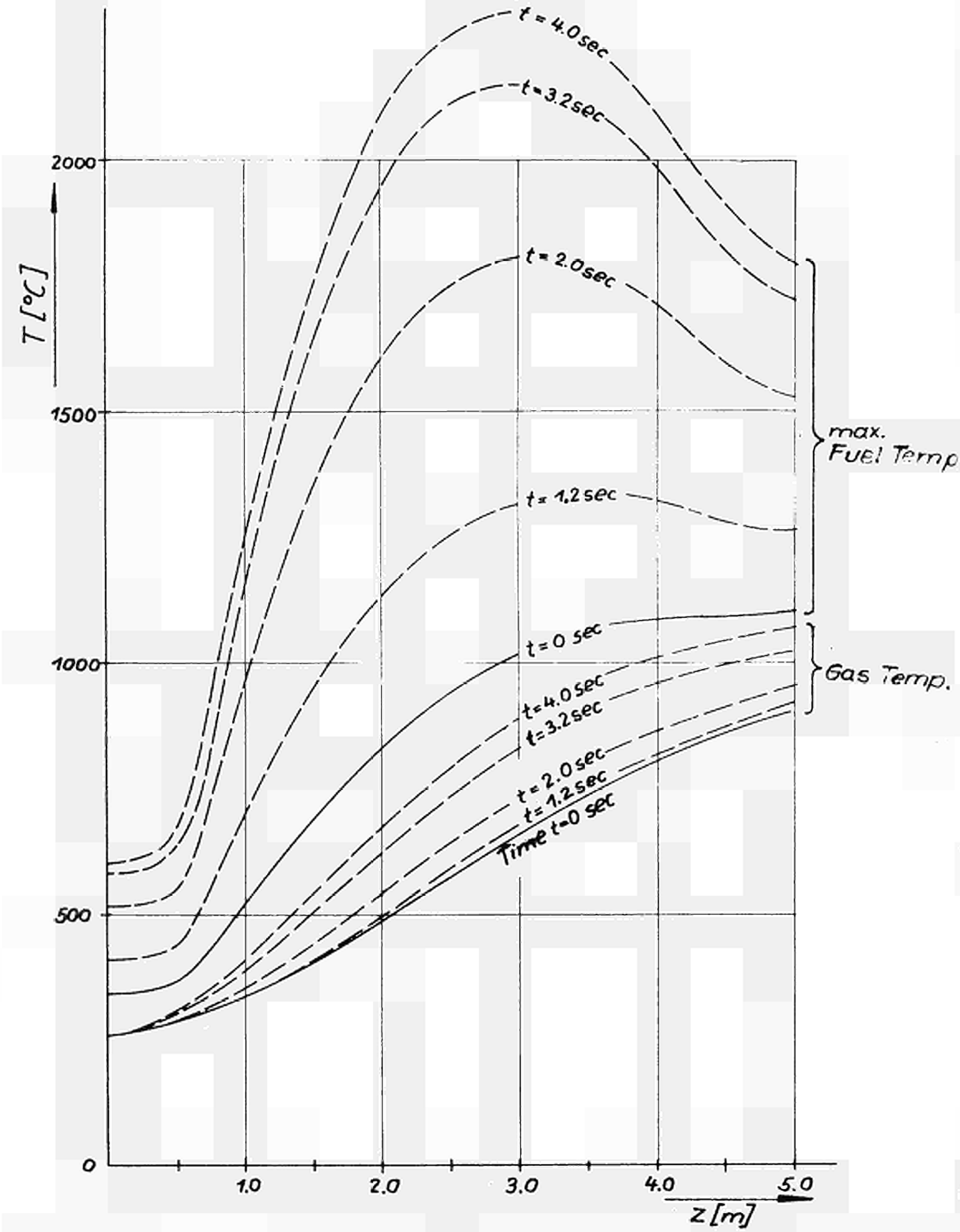
	THTR	Two zone core Reactivity ramp of 6.43°/oo in 0.002 sec. localized to region 1	Nov. 68
			Fig. 4



	THTR Reactivity ramp of 6.43‰ in 0.002 sec. Influenze of the prompt neutron lifetime on the zero dimensional calculation	Nov. 68
		Fig. 5



	THTR Two zone core, Reactivity ramp of 6.43 ‰ in 0.002 sec. Comparison between COSTANZA and DYN	Nov. 68
		Fig. 6



	THTR Two zone core, Reactivity ramp of 6.43 ‰ in 0.002 sec. Axial temperature distribution in channel 6	Nov. 68
		Fig. 7

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Alfred Nobel

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